LABS ACCOMPLISHMENTS

Exceptional service in the national interest

Sandia LabNews

March 2016

Sandia National Laboratories

To all Sandians:

When I first came to Sandia in 1983, one of the things that attracted me was that I hadn't come across any other institution in the nation quite like it. There were plenty of interesting places, plenty of interesting labs, but Sandia was different; it was engaged in fascinating work not just in one or two specialized areas but across a broad range of technical fields. I found that irresistible.

I was equally attracted to the opportunity of applying my skills in service to the nation. I liked the idea that what we did each day when we showed up for work was consequential, that the nation depended on us to deliver on the challenges it asked us to take on.

Over the past 30-plus years, I have become only more impressed with the scope of our capabilities. We are more than the sum of our parts. Our deep science and engineering foundations provide us with a cross-disciplinary advantage that lets us solve some of the nation's toughest problems.

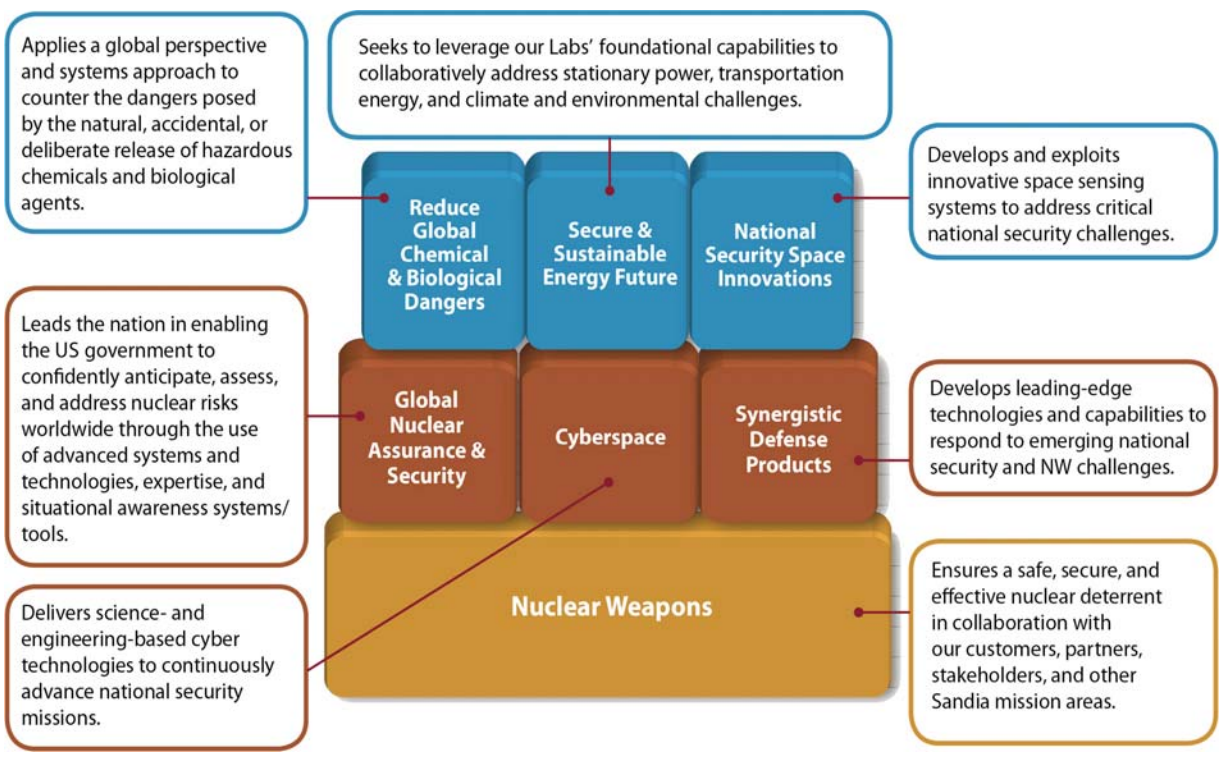
JILL HRUBY

This year's edition of *Labs Accomplishments* drives home that point. You'll read about advances we're making in solving some of the most complex problems that face the nation through our nuclear weapons and nuclear security work, in supporting our nation's warfighters, in addressing energy challenges, and in preparing for future national security threats and challenges including the ever-more-important spheres of cyberspace and biology. And we're achieving those remarkable results through teaming. I'm proud to note that we're doing our work more safely, with a more diverse workforce, and that our mission support operations are continuing to raise the bar in the integrated support they provide.

Each Sandian plays a role in *Labs Accomplishments*. If there is a theme for 2016, it is one that resonates with us all: We are here for the nation.

— Jill Hruby, Sandia President and Laboratories Director

Sandia's mission areas



Labs foundation underpins mission areas

The Laboratories' foundation — the very base that gives our institution its energy, meaning, and uniqueness — is composed of our people, research, facilities and tools, and capabilities.

In keeping with our vision to be the nation's premier science and engineering laboratory for national security and technology innovation, we recruit the best and the brightest, equip them with world-class facilities and tools, and build upon long-standing research by advancing the frontiers of science and engineering, giving rise to unique capabilities that differentiate Sandia's ability to deliver its mission.

Inside . . .

You'll see two sets of acronyms following most of the accomplishments in this publication. The first set, following the center numbers in parentheses, indicates which of Sandia's program management units (PMUs) the work most directly supported. The PMU acronyms are:

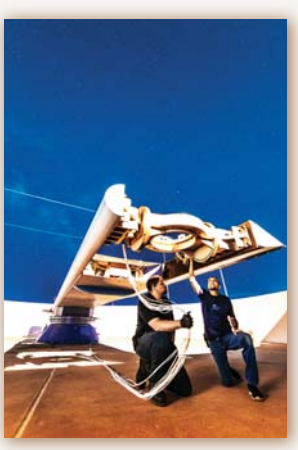
• **NW:** Nuclear Weapons • **DSA:** Defense Systems & Assessments • **IHNS:** International, Homeland, & Nuclear Security • **EC:** Energy & Climate • **IMS:** Integrated Mission Support

* * *

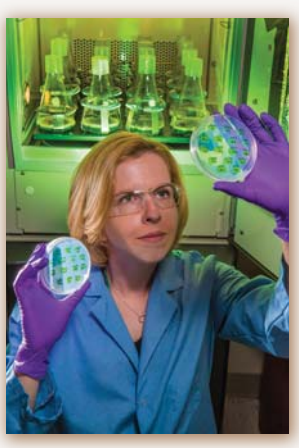
The second set of acronyms indicates in which of Sandia's mission areas the work was completed. Those acronyms are:

• **NW:** Nuclear Weapons • **GNAS:** Global Nuclear Assurance and Security • **CYBER:** Cyberspace • **SDP:** Synergistic Defense Products • **RGCBD:** Reduce Global Chemical and Biological Dangers • **SSEF:** Secure and Sustainable Energy Future • **NSSI:** National Security Space Innovations • **LF:** Laboratories Foundations

This year's *Labs Accomplishments* recognizes some of Sandia's best work during 2015, as submitted by the Labs' Center offices and selected by division offices. Most citations are followed by the numbers of the Centers that contributed most directly to the effort described.



On a starry night at a remote location at Sandia National Laboratories, technologists Glenn Yarborough, left, and Epifanio Abeyta prepare for a test at the large outdoor centrifuge. Sandia's Validation and Qualification Sciences Experimental Complex is a unique group of test facilities, including this centrifuge, that can create a broad range of engineering environments in support of Sandia's national security missions.



Sandia scientist **Anne Ruffing** studies modification of cyanobacteria for biofuel production. Bioscience is a Sandia research foundation, an area considered key to the success of Sandia's national security programs. The goal of the Labs' bioscience work is to analyze, understand, and control the functions of biological systems to meet national security challenges in biodefense, emerging infectious disease, and energy security.

Cover photographs by Randy Montoya

Exceptional service in the national interest
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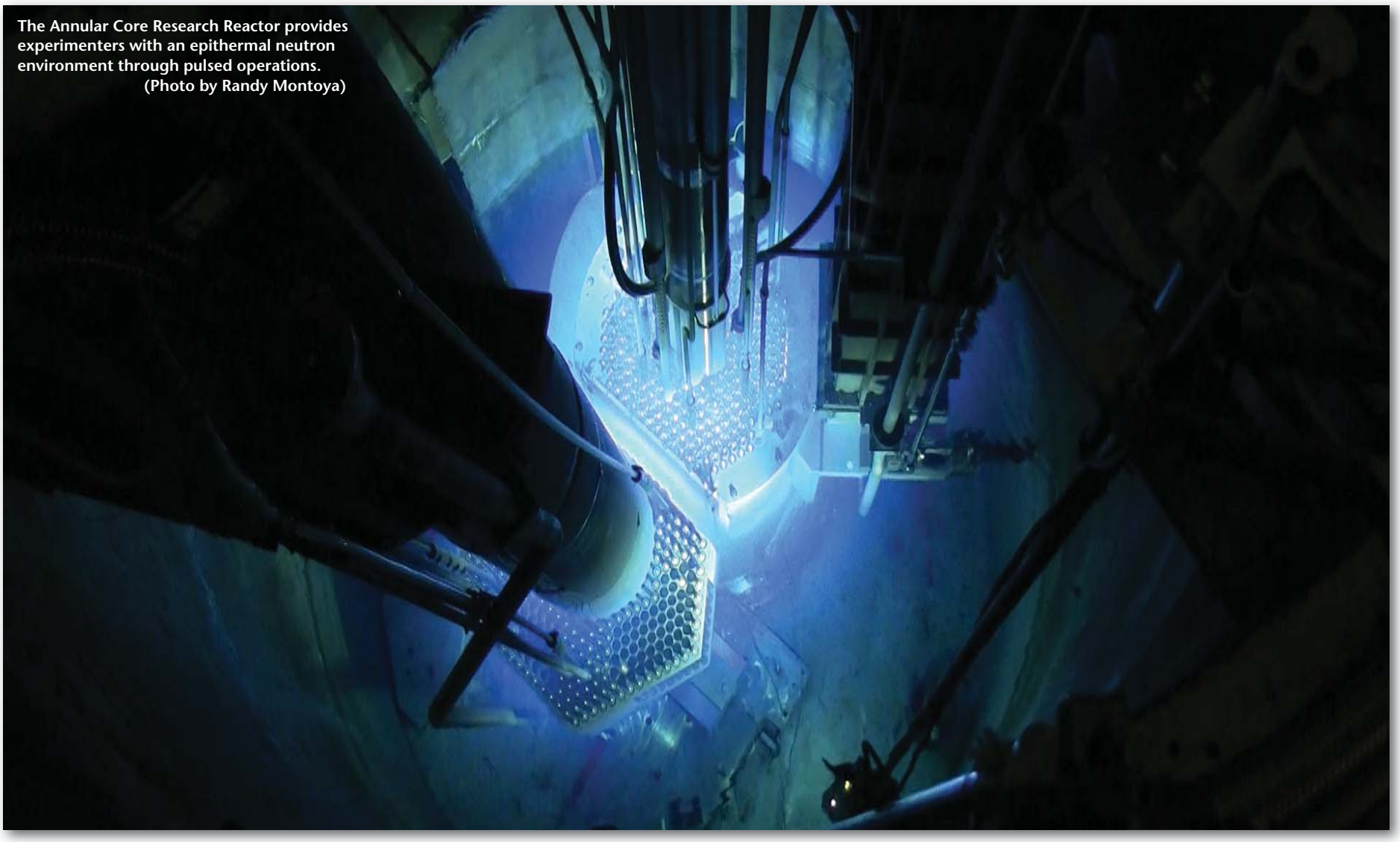
Sandia National Laboratories

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corp., for the US Department of Energy's National Nuclear Security Administration.

Nuclear weapons engineering



The Annular Core Research Reactor provides experimenters with an epithermal neutron environment through pulsed operations. (Photo by Randy Montoya)

The Annular Core Research Reactor facility provided exceptional support to the Nuclear Weapons program by providing 536 operations in FY15, a 50 percent increase above average operations levels, to support important milestones. Additionally, the facility improved capabilities by restoring its neutron radiography capability, allowing experimenters to conduct detailed non-destructive component analysis, the Fueled Ring External Cavity capability, which provides experimenters with a larger dry experimental cavity, and operations at lower neutron fluencies by upgrading nuclear instruments, providing customers low-power operations five decades below previous capabilities. (Orgs 1380, 4128) NW, NW

Partnering with the production agency at Pantex and the National Security Campus (NSC — formerly the Kansas City Plant), Sandia's on-site presence has strengthened relationships, as evidenced through semi-annual Quality Forums Sandia hosts at Pantex and Quarterly Joint Quality Managers' meetings at NSC. The Pantex Quality Forum includes government, design, and production representatives across the entire Nuclear Security Enterprise (NSE). NNSA program leads and NSE directors gather with subject matter experts to identify specific and cross-cutting weapons quality topics, share information, and implement solutions. Recent forum topics have included production schedules and resource allocation across the enterprise. (0400, 2100, 2200) NW, NW

The B61-12 Life Extension Program successfully conducted Version 1.0 Technical Basis activities, including numerous functional, environmental, and flight tests. Notable achievements included vibration fly-around (VFA) testing and the FTDU (flight test demonstration unit) development flight test series. VFA tests were used to collect environmental data, and the FTDU series was used to test early War Reserve (WR) functionality and performance and ensure the joint test assembly configuration will adequately gather data during qualification flights. Numerous departments in Sandia and partner organizations contributed to these accomplishments. (2100, 400, 1300, 1500, 1800, 2900, 3600, 5400, 8100, 8200) NW, NW

The B61-12 LEP Credible Combinations of Abnormal Environments effort applied advanced uncertainty techniques to integrate subject matter expert judgment with tangible data. A probabilistic model of abnormal environment phenomena and weapon system response was developed to capture combined scenarios (with uncertainty) that could lead to an inadvertent nuclear detonation. Results will focus experimental and numerical resources to assess the B61-12 nuclear safety design in abnormal environments. This innovative approach was supported by experts from Sandia, Los Alamos National Laboratory, NNSA, and the US Air Force. (400, 1500, 2100, 8200) NW, NW

With more than 30 courses taught in FY15 and more than 4,400 attendees to date, Sandia's National Security Quality Training (NQT) program expanded its course offerings in FY15 by 30 percent, including at other sites. New courses included Software Quality, Preventing Supplier Quality Problems, and Tester Qualification. With the high percentage of staff new to the Laboratories and a number of programs moving through critical phases of full-scale engineering development, consistent application of quality fundamentals enabled by the NQT program is central to success. (400) NW, NW

The High-Efficiency Adaptable Telemetry Transmitter (HEATT)

The High-Efficiency Adaptable Telemetry Transmitter (HEATT), being developed as part of the W88/Mk5 Alt 370 project, has been successfully tested in multiple flight tests for the Navy. HEATT is a small transmitter with improved power efficiency. Besides supporting W88 data transmission needs, HEATT is being assessed for use in other Joint Test Assembly designs. (2600, 8100, 1700, 2100) NW, NW

In FY14, one of the centrifuges used to simulate flight environments at the Weapons Evaluation Test Laboratory was taken off-line due to increased system vibration and loss of the drive system that provides power to the centrifuge motors. Expertise from across Sandia was used to fully diagnose the issues through extensive modeling, testing, and analysis. In FY15, a joint effort by Sandia, CNS Pantex, and Ideal Aerosmith Corporation resulted in a full recovery of the capability, stiffening the existing arm and replacing the drive system. (2900, 5300, 1800, 1500) NW, NW

Cybersecurity

FY15 brought the advent of the Cyber Intelligence Threat Analysis Center (CITAC), a cyber "war room." CITAC enhances the Labs' Cyber Security program's ability to address active cyberthreats against Sandia resources.

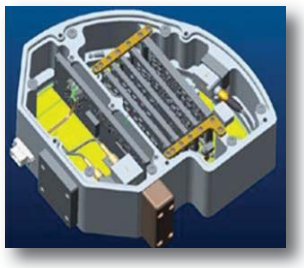
The facility promotes collaboration among Sandia's cyber defenders and other cyber experts, both internal and external to the Labs. Cyberthreat intelligence is collected and analyzed. The outcome of the analysis is shared across the Nuclear Security Enterprise with the end result being a hardened cyber environment across the complex. (9300) IMS, Cyber

Nine Test and Evaluation activities were completed for the DHS Transition to Practice Program. The program examines promising new cyber-related security technologies identified from all government laboratories, helps them understand their deficiencies (both security-related and in functionality), and provides a venue to promote their continued development toward licensing and use in both private and government sectors. (9500, 8900, 5600) IHNS, Cyber

Nuclear weapons engineering

Neutron generators (NGs) must survive explosive shock long enough to provide neutrons. This survival time, referred to as standoff, is traditionally proved through tests called "hydros." Due to programmatic considerations, hydros were not performed on a new class of NGs, although follow-on modeling predicted margin. To add confidence, NGs with delayed timer drivers were flown on Oct. 21, 2015, in JTA-331, a high-fidelity flight test unit. The neutrons measured by the Livermore raft system are consistent with expected results. Consequently, the use of a "flying hydro" provides confidence that the new W87 NGs have sufficient standoff margin. (8200) NW, NW

Sandia's B61-12 Systems Team collaborated with partners across the National Security Enterprise to successfully meet several important program milestones on time and on budget, including the Flight Test Development Unit (FTDU) series. Two of the successful flight tests occurred in FY15, on July 1 and on Aug. 11. Organization 8130 designed, built, tested, and delivered the telemetry units and detonation monitor assemblies to support the FTDU development flight test series. The telemetry unit was used to monitor and confirm that all primary pre-arming, arming, fuzing, and firing functions were executed successfully. These measurements — and their successful transmission to ground assets — were critical to overall test successes. (8100) NW, NW

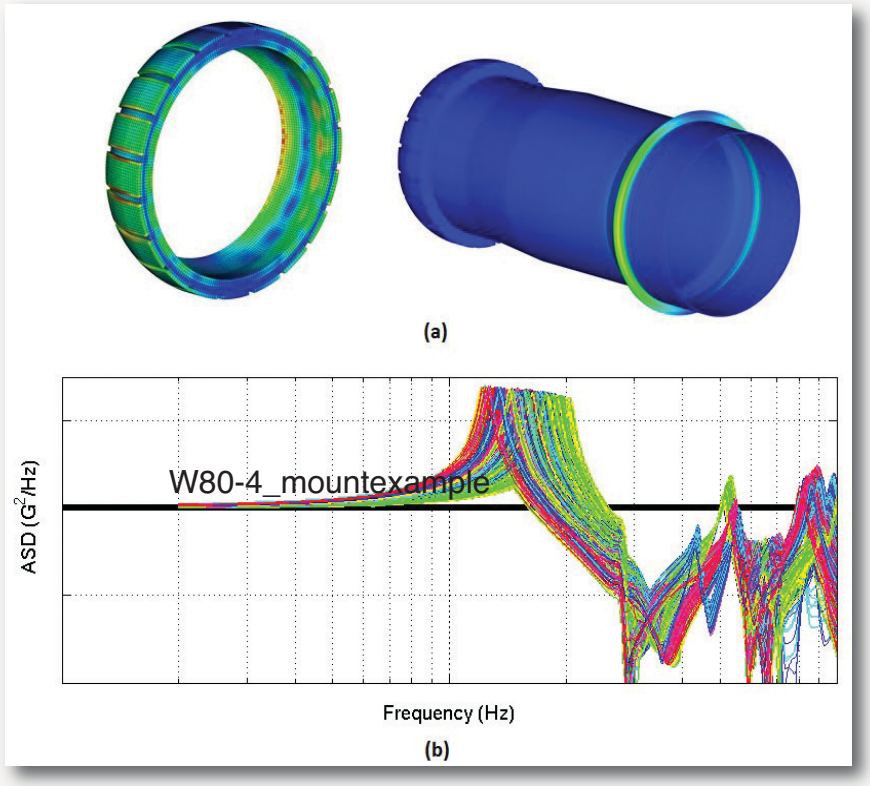


B61-12 JTA Telemetry

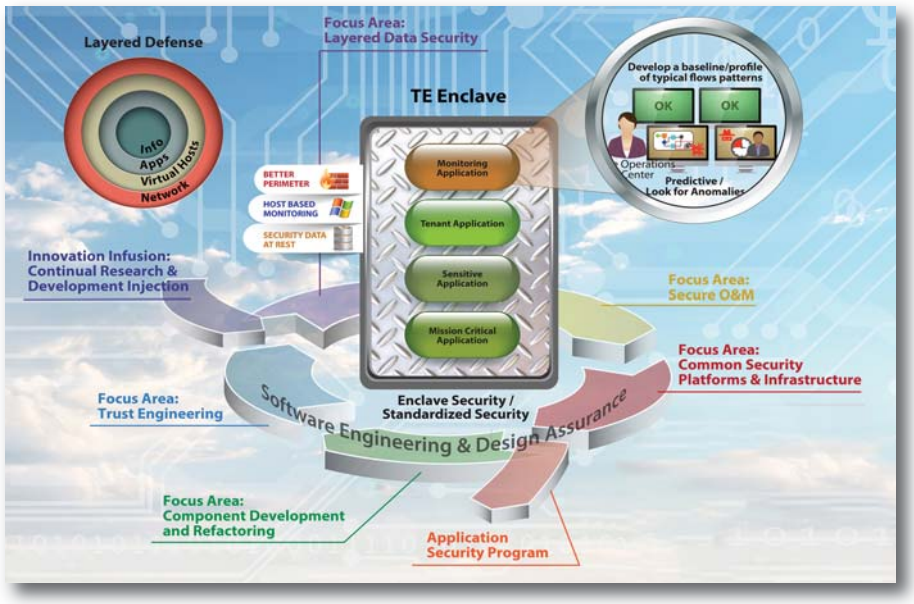
A new detonator for the W80 ALT 369 neutron generator was successfully produced and qualified in October 2015, four months ahead of schedule. The achievement is notable because it is the result of an investigation and recovery effort in response to circumstances that affected the neutron generator first production unit delivery schedule. The Sandia investigation team employed a rigorous approach that used physical and numerical analysis to develop solutions to address concerns. (2500, 2700, 1300, 0400, 8200) NW, NW

Sandia has completed fabrication of the Group 3 Common Authentication Module Application Specific Integrated Circuit (CAM ASIC) using Sandia's Rad Hard 350nm CMOS7 process. The CAM ASIC was designed for high-consequence applications. While the Group 2 CAM ASIC was fully functional, the Group 3 version uses Sandia's complete Trusted Flow. A fully functional "Alpha" version of the CAM ASIC software has also been released. (1700, 2200, 2600, 6900) NW, NW

Advanced simulation and computing capabilities were used to provide a technical basis for a W80-4 delivery vehicle mount down-select recommendation to the Air Force. The design space for three different mounting configurations was explored through the use of parametric finite element models. Insight into the sensitivity of each design parameter and the resulting range of mechanical responses during shock and vibration loading was provided through thousands of simulations. The results characterize the adaptability of each mount configuration to a future delivery platform. (8200) NW, NW



Example stress analysis (a) and random vibration excitation levels (b) for a conceptual mount design.

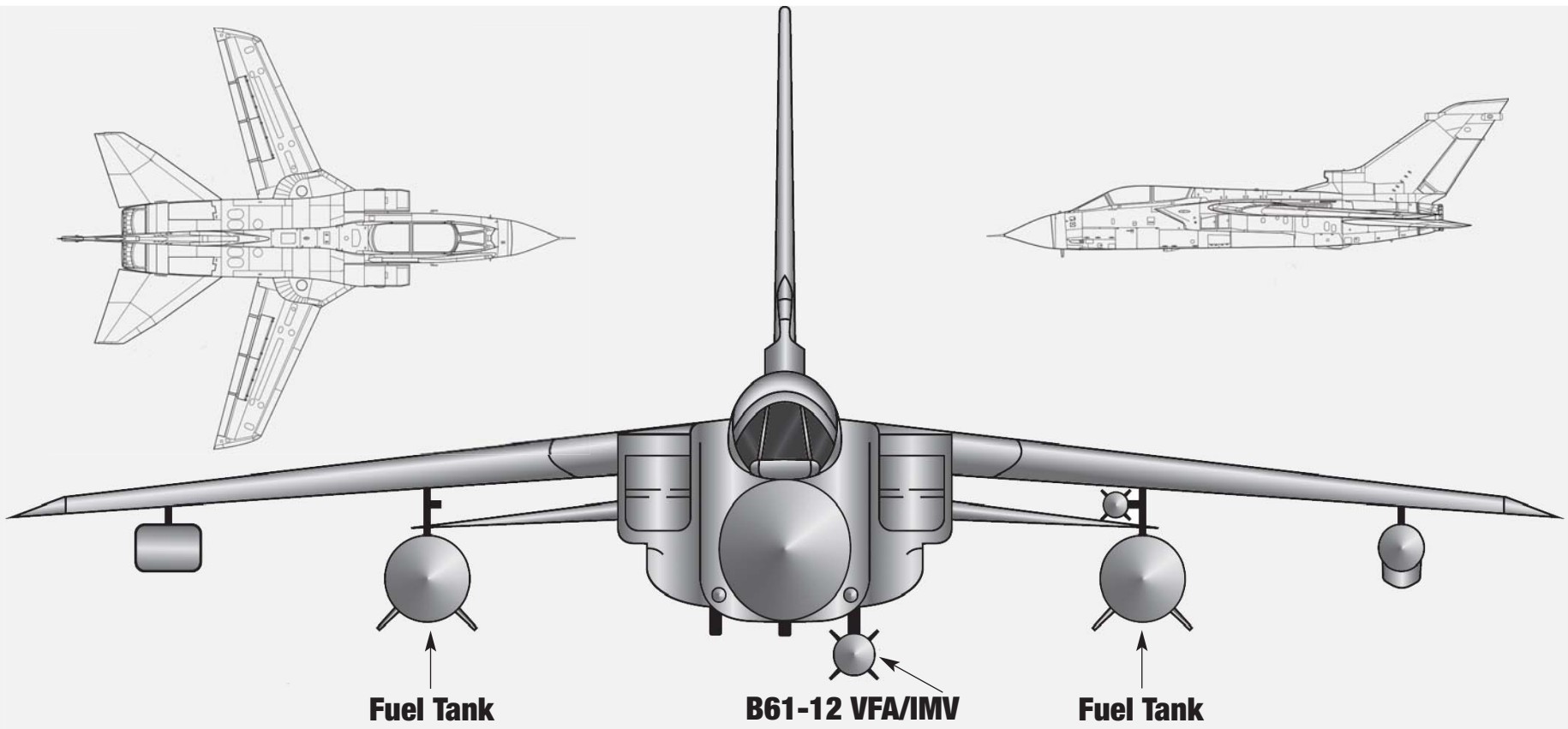


The Trust Enhancement (TE) team successfully completed a research and development project intended to both develop and implement a security enclave to protect against a broad spectrum of information security threats. TE is designed to enhance the trustworthiness of all facets of critical computing systems used at Sandia for engineering. The project implements trust engineering principles of assurance, isolation, and monitoring with the intent of providing a more secure system environment for these critical Sandia applications. (9500, 5600, 9300, 8900, 5900) NW, NW

The HERMES III (High-Energy Radiation Megavolt Electron Source) accelerator successfully fired its 10,000th shot on July 14, 2015. HERMES III began operation in early 1988 as part of the Simulation Technology Laboratory complex in Tech Area 4. It remains the world's most powerful gamma-ray simulator, producing 13 terawatts of power in a 19-million electron volt, 28-nanosecond electron beam. It produces intense bremsstrahlung doses and dose rates over large areas to study nuclear radiation effects induced by gamma-rays. (1300) NW, NW

The HERMES III (High-Energy Radiation Megavolt Electron Source) accelerator.
(Photo by Randy Montoya)

Nuclear weapons engineering



Sandia's Aircraft Compatibility team from organizations in 2900, 1500, and 2600 successfully completed a rigorous four-week/eight-flight test to characterize flight environments of the B61-12 on NATO's PA-200 Tornado aircraft. Analysis products from the test directly affect B61-12 development by defining design-level environmental specifications. Successful completion of the test is a key step in ultimately certifying compatibility of the B61-12 for wartime use with the PA-200. (2900, 1500, 2600) NW, NW

Nuclear weapon security

Sandia physical security experts were tasked with designing and implementing several security upgrades at a NATO military base in a foreign locale. The team installed several security systems, while replacing the entry control and taxi-way gates. All work was completed under budget and ahead of schedule. The Government Acceptance Test Team commented that it was "one of the best systems" they had evaluated. (6500) IHNS, GNAS

Proven engineered system to mitigate national security threats.

Responding to a nuclear terrorism incident requires interdisciplinary technical teams dispersed across the nation to urgently diagnose and recommend course-of-action alternatives to render safe imminent threat devices. Distributing technical data from the field working point to home teams that analyze diagnostic images and technical data has now been greatly simplified using Sandia-developed DataShare applications. Sandia DataShare now automatically routes electronic files through specialized channels to decision-makers, accelerating timely decisions. (6600) IHNS, GNAS

Sandia will start the development of the Mobile Guardian Transporter (MGT) for the NNSA Office of Secure Transportation (OST). The MGT is the third-generation secure system for over-the-road transport of weapons and special nuclear materials within the United States. It will take several years to develop, and the effort will require expertise from across Sandia as the safety and security requirements for the new transporter are rigorous and challenging. (6600) GNAS NW

JOHN CLAUSS

John Clauss (2137) successfully led the W88 ALT 370 team to full integration of technical requirements, demonstrating that all requirements have been traced and flowed to major components using modern database tools. The completion of this significant milestone resulted in the project team gaining trust with customers and senior management. John provided vision, leadership, and the ability to execute under tight system engineering constraints. The effort required collaboration from a set of teams across Sandia, partner, and customer organizations including LANL, NNSA, and the Navy.

W88 drop test

Remote sensing

The United States Nuclear Detonation Detection System (USNDS) monitors the globe from space for nuclear detonations. This year, the Sandia/LANL/Boeing team launched three payloads to orbit. The US now has 11 Sandia-designed Enhanced Optical Burst Detectors on orbit. The flight segment also passed its second AS9100C surveillance audit, receiving the highest possible scores. The USNDS ground segment achieved a significant milestone when its latest generation of the Integrated Correlation and Display System (ICADS) was accepted by Air Force Space Command and certified for use by US Strategic Command. (5700, 5500, 5300, 2600, 10600) DSA, GNAS

Launch of GPS IIF-11 aboard a United Launch Alliance's Atlas V rocket on Oct. 31, 2015.

The Atom Trap Trace Analysis (ATTA) team successfully demonstrated the trapping of atoms in a vapor magneto-optic atom trap (MOT). This research, funded by the NNSA Office of Proliferation Detection, aims to use ATTA to explore a quantum sensing technique for high-sensitivity, high-precision detection. (8100) IHNS, GNAS

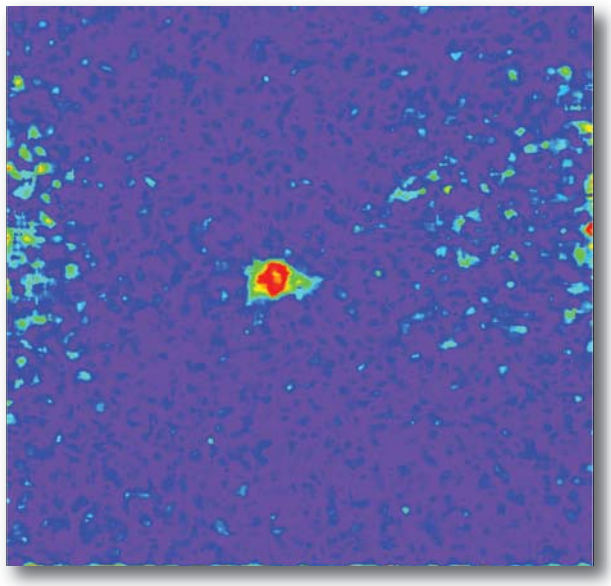


Image of the MOT cloud is shown here; its diameter is 1.5mm, consisting of approximately 10 to 20 atoms.

Jim Chow (5349), Kristina Czuchlewski (5346), and Steve Castillo (5346) were selected for the Intelligence Integration National Intelligence Professional Award. The office of the Deputy Director of National Intelligence for Intelligence Integration depends on support from analysts and other contributors across the intelligence community to meet its responsibilities to produce community-coordinated strategic analysis. All three individuals are key contributors on the PANTHER Grand Challenge LDRD and have worked tirelessly with the national security community to build Sandia's reputation as an activity analytics innovation cell. (5300) DSA, SDP

Partnering with HH Seismic LLC, the University of Nevada Desert Research Institute, and NSTec, Sandia led a first-ever seismic survey of Yucca Flat at the Nevada National Security Site (NNSS). Utilizing a highly-specialized Seismic Hammer (dubbed "Thor"), the team "hammered" its way across 31 kilometers of the test site. These first-in-the world tests used more than 400 seismometers and infrasound sensors to capture precise information of Thor's emanations. The seismic and infrasound experimental results will be used to improve modeling in support of worldwide underground nuclear test monitoring. (5700, 6900, 1600, 5400, 6500,10600) DSA, IHNS, GNAS

The mechanical overhaul and major upgrade of the Tech Area 4 antenna control systems were completed in May 2015. This multi-year effort included significant enhancements to the tracking and control architecture providing decades of additional service and platforms where Sandia may launch R&D investigations in data exploitation, cyber security, and cyber vulnerability. This upgrade enables our ongoing effort to develop reconfigurable systems, capabilities that involve wider telemetry band recovery, improved digitization hardware, decryption processes, algorithm & data processing development, and secure data dissemination to users. DSA, NSSI

Tech Area 4 antenna control systems.

Global security

In May 2015, CRC Press published a book edited by Jen Gaudioso (6820) and former Sandian Ren Salerno, *Laboratory Biorisk Management: Biosafety and Biosecurity*. This book introduces a substantively new approach for managing the risks of working with biological agents in laboratories. The basis for this new biorisk management paradigm is a three-pronged multidisciplinary model of assessment, mitigation, and performance (the AMP model). The application of the methodologies, criteria, and guidance outlined in the book helps reduce the risk of laboratories becoming the source of infectious disease outbreaks. (8600, 6800) IHNS, RGCBD

The Daily Watch Program developed by Neall Doren (5962) is a new analysis tool for the US government. This technology has seen a steady increase in user requests from 100 requests a month three years ago to more than 1,000 per month. The FY15 software, delivered and assimilated by the government, is based on a joint effort between organizations 5448 and 5962 and takes advantage of organization 5448's Automatic Target Recognition research and development technology. (5400, 5900) DSA, GNAS

The Starlite - Synthetic Aperture Radar (SAR) - Coherent Change Detection (CCD) development, funded by the US Army, was conducted by Neall Doren (5962). It resulted in the delivery of CCD software and documentation. The objective was a CCD software package that will allow CCD imagery for improvised explosive device detection. The intent of the work is to provide the Grey Eagle UAV/Starlite SAR System the capability of both the Copperhead radar/UAV and Desert Owl radar system to detect IEDs on the battlefield. (5900) DSA, SDP

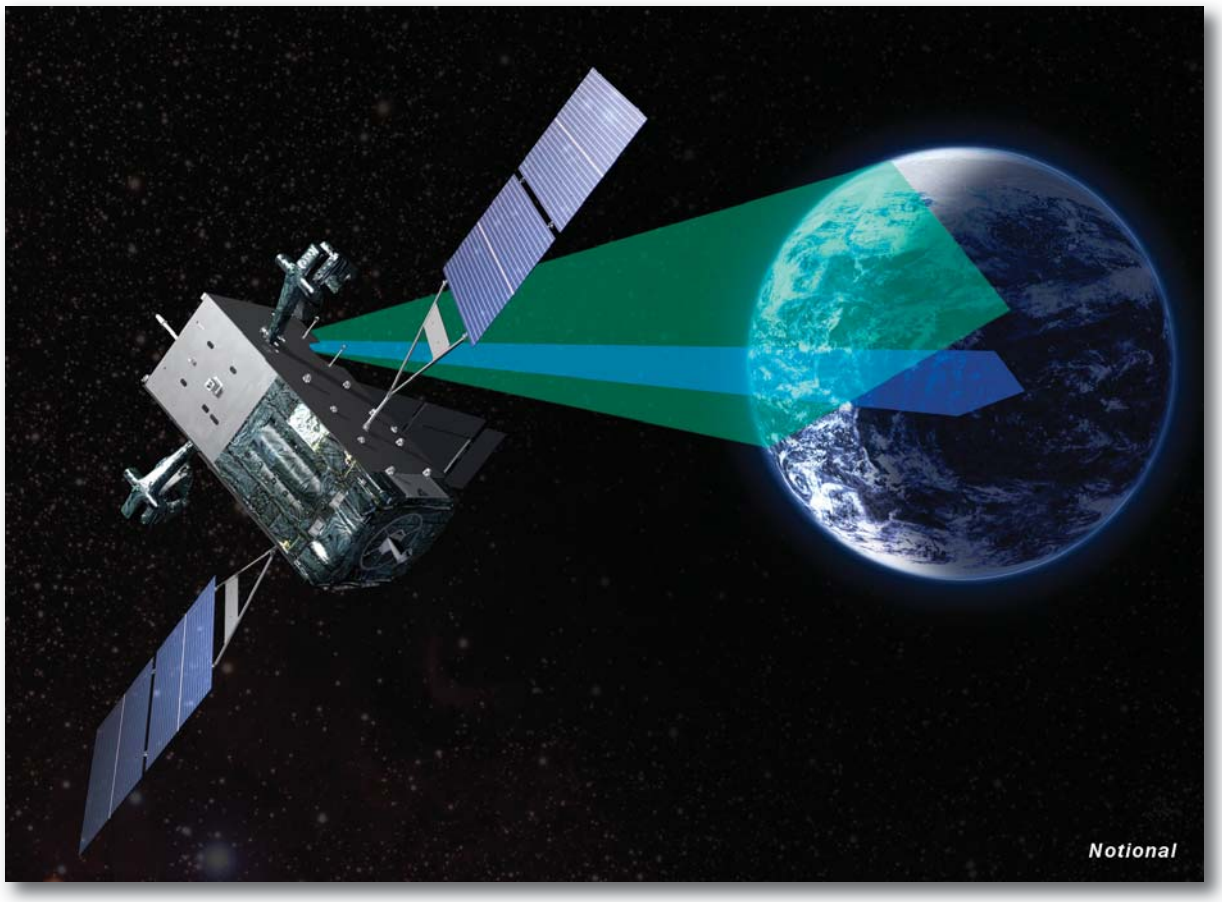
From April 20-May 8, 2015, Sandia hosted 43 nuclear security students from 36 nations for the 25th International Training Course (ITC) on the Physical Protection of Nuclear Material and Nuclear Facilities. Top officials from Sandia, NNSA, and the International Atomic Energy Agency welcomed the students. Every 18 months for the past 37 years, Sandia has hosted the ITC, thus far training more than 800 people from 73 countries. The two-week course provides technical experience and helps build connections among members. (6800) IHNS, GNAS

Ryan Kamm explains to a delegation of international visitors some of the principles behind Sandia's Z machine.

Pablo Garcia (left) discusses Sandia's work in nuclear safety with Anne Harrington of the NNSA and Denis Flory of the IAEA. Harrington and Flory toured Sandia's facilities during the 25th International Training Course.

During 2015 Sandia hosted two visits by delegations of international nonproliferation and disarmament officials. They came to learn about the Labs' work related to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The delegates represented 19 non-weapons states, the UN Office of Disarmament Affairs, and NATO. Both delegations were given tours of Sandia technical facilities where important NPT work is conducted. The goal of these transparency visits was to introduce the officials to Sandia's workforce and to demonstrate our technologies that support nonproliferation, arms control, and US implementation of the NPT. (6800) IHNS, GNAS

Remote sensing



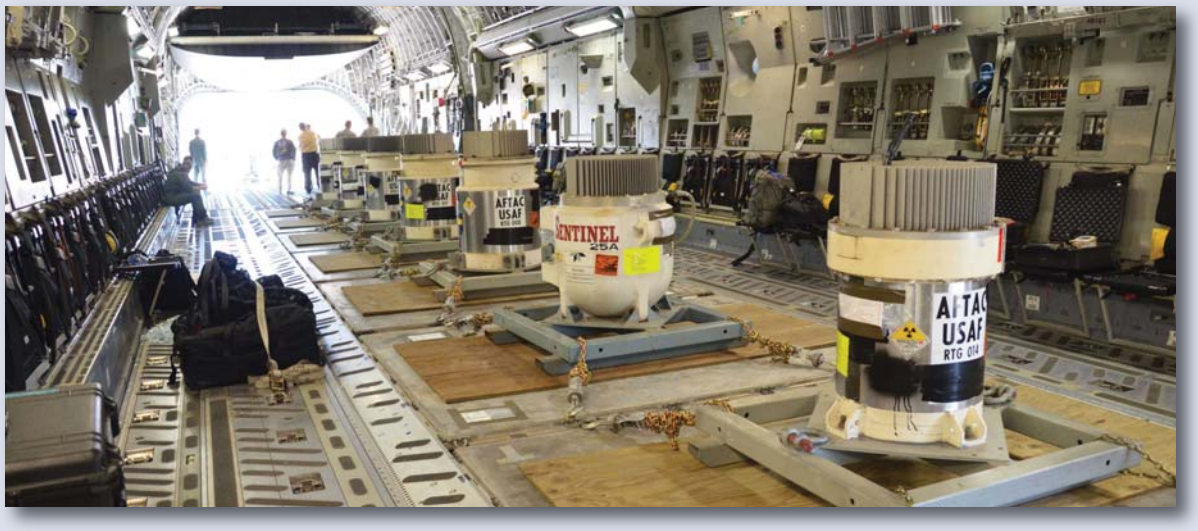
The GEO Starer Processor (GSP) Team has provided complex real-time processing of Overhead Persistent Infrared data from SBIRS (space-based infrared system) Geo1 and Geo2 staring sensors, providing this capability in just over three years. The team leveraged decades of experience in sensor data processing, LDRD, and other R&D activities to achieve this unprecedented capability under an accelerated schedule at the request of senior government leaders. GSP became operational in November 2015, providing enhanced situational awareness to our combat commanders, protecting our warfighters, and enhancing the nation's security. DSA, NSSI

Using only 196 pounds of TNT in a contained environment 286 feet below ground, a multi-lab team successfully conducted Source Physics Experiment #4 (SPE-4) at the Nevada National Security Site. Conducting one of 18 planned experiments, the SPE-4 team gathered high-resolution accelerometer, infrasound, seismic, electromagnetic, ground-based LIDAR (light detection and ranging), digital photogrammetry, and satellite-based Synthetic Aperture Radar data of this modest shot. These data will be incorporated with similar data from previous shots to strengthen models and systems used to detect low-yield underground nuclear explosions. SPE-5, scheduled for FY16, will include 5 tons of explosives. (5700, 6900, 0400, 1500, 1600, 5400, 5900, 6200, 10600) DSA, IHNS, GNAS

Workers at the Nevada National Security Site position equipment to conduct the SPE experiments.

ES&H & security

Sandia's Waste Management team supported the US Air Force to transfer excess nuclear materials from the Alaskan Arctic Circle area to the Nevada National Security Site. The material originated from 10 radioisotope thermoelectric generators that were once used as a power source by the Air Force Technical Applications Center. While the partnership began in 2001, the July 2015 transfer represented several years of collaboration and planning to safely dispose of the hazardous material. (4100) IMS, LF



Seven radioisotope thermoelectric generators are lined up aboard an Air Force C-17 Globemaster III after being removed from Burnt Mountain, Alaska, and transported to Creech AFB, Nevada, July 24, 2015, in preparation for permanent disposal at the Nevada National Security Site. (US Air Force photo by Susan A. Romano)

During the 2015 DOE Office of Enterprise Assessments (EA-22) audit of Sandia's Security Program, the EA-22 team identified Sandia/New Mexico as effectively managing security operations. Additionally, the EA-22 team noted a number of best practices at Sandia that should be shared across the complex. This was the first audit of this type since 2007 and, with the many changes that have occurred at Sandia since then, it was an accomplishment to have an external audit team recognize Sandia's demonstration of "excellent continued sustained improvements." (4200) IMS, LF

Sandia's Emergency Response Team (ERT) successfully responded to the challenges presented during the Hazmat Challenge held at Los Alamos National Laboratory and was awarded First Place in the Technical Category. The ERT's skills were tested along with those of 10 other teams from New Mexico, Missouri, and Nebraska through various environments such as clandestine laboratories, multiple modes of transportation, industrial piping scenarios, simulated radiological releases, and a confined space event. These challenges provided Sandia the opportunity to demonstrate proficiencies and, as a result, give members of the workforce confidence that these skills would transfer to real-world incidents at Sandia. (4200) IMS, LF

The winter of 1997-1998 was the last strong El Nino event in California and many remember the significant flooding that occurred at the Sandia/California site. Since then, Sandia has been working in partnership with the US Army Corps of Engineers to repair that damage and prevent future flooding events via a 10-year Arroyo Seco Improvement Program (ASIP). The ASIP consists of 18 projects along the Arroyo Seco, the most recent of which, the development of a flood plain with trees and native shrubs, will help slow run-off and provide habitat for sensitive species. (8500) IMS, LF

Security Information Systems (9521), along with Classified Matter Protection and Control (4254-1), developed a new Classified Mail Channel (CMC) application. The previous application only had an administrative feature in which the CMC administrator inputted all data from a hard copy form submitted from the customer. The new application automated the hard copy form and incorporates engineered controls, which improves data integrity. The workflow is now automated and has reduced the processing time by 75 percent. (9500, 4200) NW, NW

Center 4800 finished FY15 with the best safety record to date, with a total recordable case rate of 1.15 compared to the corporate rate of 1.31. This achievement in safety excellence is a reflection of cultural and behavioral practices of the entire center. Every day more than 300 maintenance workers, 300 construction personnel, 60 service contractors, and 175 additional professional employees perform activity-level work throughout the Sandia campus. Each individual is part of this success metric because safety and critical thinking are engrained in Facilities Management and Operations Center Work Planning and Controls. (4800) IMS, LF

The Foreign National Information System (FNIS) is used by the Labs to create security plans for foreign national visitors and to document foreign interactions. Departments 9521 and 4225 teamed to design and develop a new FNIS application. A fundamental requirement for the application was usability and reliable performance. The new application was benchmarked against the existing production system and is 15 times faster than the old application, which equates to an efficiency of approximately 56 hours per year, per approver, presuming 100 FNRs a month. (9500, 4200) NW, NW

Product realization

The newly configured B61 JTAM.

The JTA Modernization (JTAM) Project team developed a new Instrumentation System with a flight recorder as well as transmit capabilities for the collection of critical weapon performance data. This system provides an extensive increase in the flight-surveillance capability for the B61-3, 4, 7, and 11. The JTAM team delivered six system-level First Production Units in 2015. Project success is the culmination of more than four years of teamwork and dedication by many organizations, teams, and individuals. (2200) NW, NW

FY15 saw the initiation of Sandia's largest production effort for War Reserve Mark Quality application-specific integrated circuits (ASICs) to be delivered for various weapon systems. Multiple ASICs are used in these systems, and hundreds of ASICs were delivered to Major Components in FY15 for design maturation and product qualification efforts. This accomplishment is the culmination of significant effort by teams in Center 1700 and across Sandia, including 1300, 1800, 2100, 2200, 2500, 2600, 5300, and 8200. NW, NW

The W88 ALT 370 DASO-26 Systems Team

W88-0/Mk5 ALT 370 activities are proceeding and meeting critical program milestones, including critical flight tests and ground tests, design reviews, and program reviews. The data from ground and flight tests enable the design and development teams to verify full functionality and support ongoing development efforts. The successful development activities have been accomplished by a multidisciplinary team including Sandia, Los Alamos National Laboratory, Lockheed Martin Space Systems Corp., John Hopkins Applied Physics Laboratory, the Naval Surface Warfare Center Dahlgren Division, NNSA, and the US Navy's Strategic Systems Programs Office. NW, NW

NNSA announced Oct. 23, 2014, that it had reached the halfway point in the production phase of the W76-1 Life Extension Program (LEP). The program involves engineers, scientists, and technicians from across the National Security Enterprise. The LEP first production unit was completed in September 2008 and the program remains on track to produce and deliver W76-1 warheads to the Navy to honor the commitment from NNSA to complete production later this decade. (400, 2200) NW, NW

Mylar films are used in modern nuclear systems for pulse discharge capacitors to ensure high reliability with irreversible inoperability upon exposure to abnormal thermal environments. Sandia developed a chemical processing capability to impart radiation tolerance to Mylar films for the W88 Alt370 program. The production rate was improved from 300 feet per day to 13,000 feet, ensuring an ample supply of film will be available to meet program needs. Recent radiation effects testing demonstrated robustness, while multiple capacitor builds have demonstrated high reliability. (2600, 1800) NW, NW

Analysis, functional, normal, and abnormal environment testing was performed on eight safety mechanism products in their second development group for the B61-12 and W88 ALT 370. Simultaneous product realization for eight devices of this type has not been accomplished for more than 30 years at Sandia. This is being accomplished using high-performing teams that combine experienced leads, skilled technologists, and a large group of talented newer staff members who arrived at Sandia well trained to contribute immediately and who are excited about making an impact. (2600, 0400, 2900, 1800, 1500) NW, NW

In FY15, the Electronic Neutron Generator Product Realization Team completed its planned development and problem-solving builds on schedule and with yields higher than expected. Reasons for the high yields include lowering the high-level risks (high voltage breakdowns and loss of bias) through problem-solving activities that led to the implementation of effective countermeasures, and building the units on the production floor, leveraging as much as possible the manufacturing infrastructure early in the development phase. (2700, 2600, 400) NW, NW

Sandia partnered with the National Security Campus to produce development hardware using metal-based additive manufacturing. Testing results have proven that the printed part can withstand a 150-percent increase in the impact load over the corresponding machined and welded design. This is due to topology optimization that is only possible to produce through additive manufacturing. The team is now engaged in fully understanding the material properties and manufacturing process variability to determine if printed parts can be qualified and accepted as diamond-stamped product. (2900, 2100, 1800, NSC) NW, NW

To support increasing demands for lower measurement uncertainties associated with the calibration of dimensional gauges and fixtures for Sandia's Neutron Generator Enterprise, Mechanical Calibration has acquired a high-accuracy (i.e. sub-micrometer) coordinate-measuring machine. The fully numerically controlled machine is equipped with both a tactile and non-contact optical probe sensor for inspection of components using 3-D CAD models. High-speed active scanning data collection along with computer-aided accuracy optimizes precision measurements. To achieve high accuracies, the system is equipped with low-expansion coefficient scales and elastomer vibration air damping. (2500) NW, NW

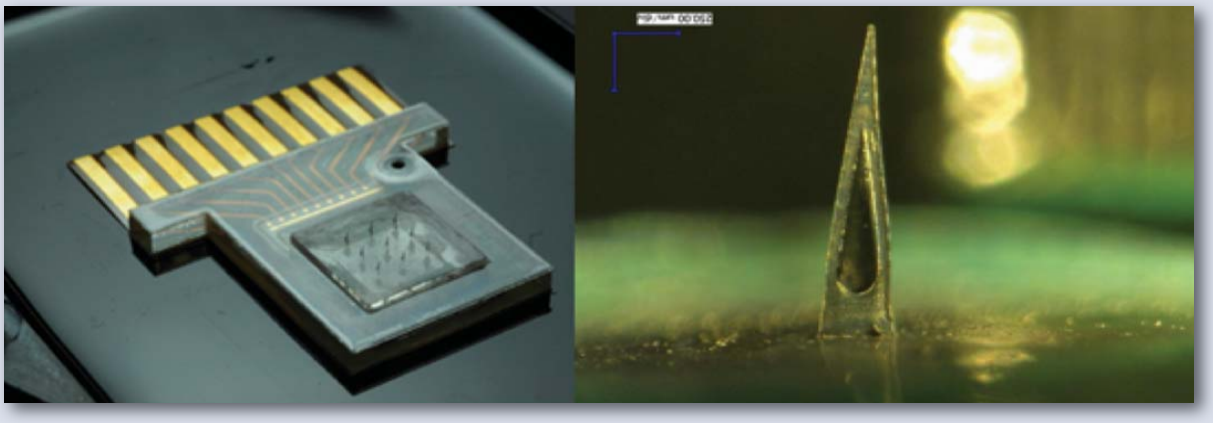
The NNSA-wide enterprise modeling and analysis consortium (EMAC) team executed the Sandia-developed Complexity Options, Risk and Evaluation (SCORE) model and process, used again this year by NNSA's Office of Budget Execution, Cost and Financial Management as a basis for cost model calculation and incorporation in the 2017 Stockpile Stewardship and Management Plan. Similarly, EMAC used the Sandia-developed tritium supply and demand model to enhance integration within NNSA and the design agencies and production agencies supporting both the NA-12 Tritium Change Control Board and the NA-19 Tritium Supply Program. (200) NW, NW

The first W78/Mk12a Extended Range Instrumented Flight Test was launched from Vandenberg AFB on March 23, 2015. This was the longest flight distance ever flown by a W78/Mk12a instrumented flight vehicle. The system performed nominally and the test was scored a success. This important test provided new performance information in stressing environments, improving our technical basis. This is especially important given the extended deployment period of the W78. The Air Force, Navy, and NNSA and its complex all contributed to this successful mission. (2200, 0400) NW, NW

Launch of the Minuteman III Intercontinental Ballistic Missile from Vandenberg Air Force Base, carrying an instrumented W78 Joint Test Assembly for the W78/Mk12A Extended Range Instrumented Flight Test.

Bioscience

Sandia has developed arrays of microneedles integrated with electrochemical biosensors to monitor an individual's state of health in real time by analyzing interstitial fluid sampled through the skin. In vitro laboratory experiments have demonstrated the detection of fatigue biomarkers such as glucose, lactate, and pH. Preliminary human studies, funded by the Defense Threat Reduction Agency, are being conducted in collaboration with the University of New Mexico Health Sciences Center, with the goal of correlating interstitial sampling with conventional blood sampling. (1700) IHNS, RGCBD

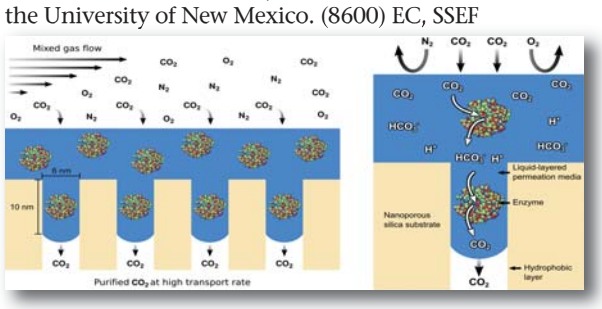


Nine-element microneedle array in plastic laminate fluidic manifold (left). Image of a single hollow microneedle (right).

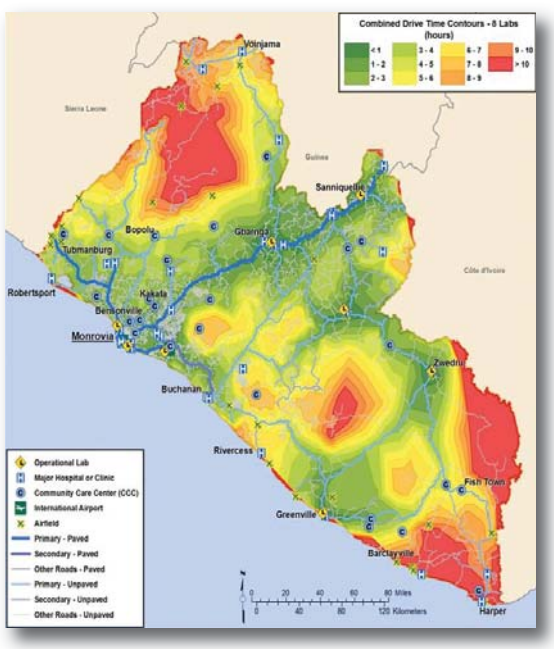
TAMARA G. KOLDA

Tamara G. Kolda was named a Fellow of the Society for Industrial and Applied Mathematics (SIAM) at the International Congress on Industrial and Applied Mathematics in Beijing, China, an honor reserved for SIAM's most distinguished members. She is only the 3rd Sandia scientist to be named a SIAM Fellow, and was recognized for "contributions to numerical algorithms and software in multilinear algebra, optimization, and graph analysis." Tammy's research interests also include tensor decompositions, data mining, nonlinear solvers, parallel computing, and the design of scientific software.

Sandia led the development of a revolutionary membrane that selectively captures CO_2: the CO_2-Memzyme. This technology could save the US coal industry $90 billion a year for electricity generation compared with best-in-class CO_2 capture technology. It has a 3-times faster permeation rate, 20-times higher selectivity, and 7-times lower fabrication cost. The ultra-thin membrane uses an active enzyme that is stable for months over large temperature ranges. Center 8600 led the effort; other contributors were from the University of New Mexico. (8600) EC, SSEF



Schematics showing the structure of the Memzyme's active layer. The membrane captures and releases only CO_2 at fast rates) via specially designed nanopores that trap a thin layer of water (blue) loaded with CO_2-enzymes.



Contour map showing drive times and Ebola lab coverage in Liberia.

Sandia has been providing technical assistance to West Africa as part of the effort to control the Ebola epidemic. In Liberia and Sierra Leone we analyzed infrastructure and laboratory networks to improve sample transport and optimize laboratory placement. In Guinea and Sierra Leone, numerous Sandians served as laboratory coordinators for diagnostic laboratories. In Liberia we responded to an urgent request from the US National Security Council to help clear a blood sample backlog. As the epidemic recedes, Sandia is helping transition resources to local jurisdictions. (6800, 6100) IHNS, RGCBD

Computer & information sciences

Sandia conducted an extensive benchmarking study of one of the world's first commercial quantum computers, produced by D-Wave Systems Inc. and housed at NASA's Ames Research Center. D-Wave's systems employ quantum annealing to solve discrete-optimization problems with potential mission-relevant applications; the current generation offers approximately 1,100 quantum bits. The multidisciplinary Sandia team devised new mathematical techniques to enable benchmarking of more realistic problem instances and identified critical bottlenecks to real-world applications. A technical report detailing the findings has been widely distributed and well received. (1400, 5600) DSA, Cyber

The D-Wave 2X quantum computer natively solves a broad class of discrete-optimization problems leveraging its approximately 1,100 qubits or quantum bits. (Image courtesy of D-Wave Systems Inc.)

A team led by Peter Maunz (1725) has recently achieved world best fidelity levels (> 99 percent) for a two-qubit gate using trapped ions in devices from Sandia's MESA facility. Manipulation of the quantum states of individual particles can unlock the potential of quantum computation. These states are exquisitely delicate and the ability to effectively control them is often measured through the fidelity of operations involving these particles. The team is tantalizingly close to the fault-tolerant levels theoretically required for arbitrary computation. (1700) DSA, Cyber

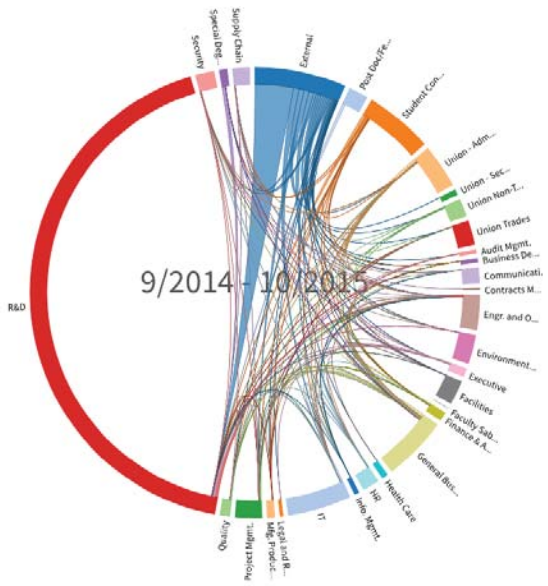
Sandia WeaselBoard technology has been integrated into a land-based version of a Navy ship control system. The WeaselBoard provides an added layer of cybersecurity for the programmable logic controllers that control essential processes on the ship. Testing results showed that the unit properly identifies and alerts on unauthorized configurations. Additional rules are being developed that will help ensure that the programmable logic controller operates only as intended by design. (5600) DSA, Cyber

Sandia's Lightweight Distributed Metric Service (LDMS) is the first platform-independent monitoring tool providing near-real-time, synchronized, high fidelity, system-wide awareness down to one-second-or-less intervals across tens of thousands of nodes without adverse impact on running applications. LDMS data is unique in scope and fidelity, enabling fundamentally new insights about, and responses to, system and application performance. LDMS is included in the NNSA Tri-lab operating system stack and its deployments include NCSA's Blue Waters (27,648 nodes) and the Tri-labs. LDMS is a 2015 R&D 100 Award winner. (9300) Cyber

Sandia has developed unique analytics to support long-term sustainment of Nuclear Security Enterprise capabilities and resources through identifying optimal production plans, capacity constraints, and critical investments required to ensure readiness and stability. These tools have been applied broadly to component production modeling, stockpile evaluation planning and operational modeling, and life-of-program production logistics models. In FY15 the capabilities were used to support the Annual Assessment Report, inform schedule decisions, and analyze the impact of emerging situations such as the Explosives Consolidation Implementation at WETL and operational pauses at Pantex. (6100) NW, NW

IT, networks, & facilities

Analytics for Sandia Knowledge (ASK), a new tool primarily for managers, allows users to find data from multiple Sandia sources and integrates and presents the results in dashboards, visualizations, and interactive capabilities. The initial set of capabilities includes integrated HR and other data for detailed analyses, tools for understanding organization and personnel expertise, staff transitions, workforce education, employee retention, and organizational safety. Future capabilities will integrate additional data sources and methods to interact with it. (9500) IMS, LF



This ASK visualization shows movements between and among groups of staff at Sandia over various time periods.

Building 705 IGPP (institutional general plant projects) construction was completed in October 2015 within budget and with zero safety incidents. It is the fourth of five

Building 705 in Tech Area I.

institutional assets constructed with IMS funding, in accordance with an LLT agreement in FY12. The building provides offices and light laboratory space to benefit multiple mission elements, including ongoing science and technology activities and major program initiatives. The three-story, 26,000-square-foot structure is located in Tech Area 1. (2900, 4200, 4800, 9300, 10200) IMS, LF

Center 4800 restructured all its major planning documents to provide a foundation for a corporate investment strategy that matches division priorities to the appropriate funding sources. This effort started with the Long-Range Development Plan and Long-Range Development Framework, along with the Technical Area Plans, which provide the structure for the short- and long-term planning within the context of the entire Laboratory. In turn, Facilities and Infrastructure Plans were developed by each division to articulate their needs, which will then inform the Five-Year and Ten-Year Site Plans. IMS, LF

The Videoconferencing and Collaborative Technologies team engineered and deployed a new videoconferencing infrastructure providing Virtual Meeting Room (VMR) capabilities for unclassified videoconference meetings. The new system will allow location-independent videoconferencing by assigning a VMR number that uniquely identifies a meeting. Using that number, meeting participants can join from wherever they are, even at the airport or off-site. Compatible technologies include traditional videoconferencing room systems, a Lync Room System, Skype for Business on a desktop, and even an iPhone or iPad. IMS, LF

NEW VIDEOCONFERENCING CAPABILITIES — Jeff Jortner, Diane Gomes, Joshua Crawford, and Corbin Stewart (all 8944) hold a videoconference with Lanette Radliff (8944-1). They were all part of the team that spearheaded the new video capabilities.

Public Key Infrastructure (PKI) Two-Factor Authentication is now operational for the Sandia Partnering Network. To date, more than 700 users are able to use PKI credentials for system access, with an anticipated additional 600 users by February 2016. This milestone marks the largest implementation and achievement of a key NNSA project related to smart card usage. IMS, LF

The Red Remote tool implementation was expanded from the SRN environment to include users on the SCN. The tool allows a technician to troubleshoot and provide support. This reduces support of a typical request to install software from several hours to about 10 minutes. As a result, customers are now able to get a solution with a single call and return quickly to making the mission successful. (9300) IMS, LF

Enterprise BI (9548) and Nuclear Security Enterprise & Cost Analysis (0157) partnered to build the Cost Data Continuum (CDC) tool based on Excel pivot table technologies that are readily usable by analysts. This tool enables analysts to recreate programmatic cost datasets going back to 1994 to aid current estimators responsible for planning Sandia's future programs. Initiatives that formerly required months and hundreds of hours to complete now require as little as a day while ensuring a repeatable, traceable, valid, and credible process. (0150, 9500) IMS, LF

Partnerships & alliances

Small Business Vouchers Pilot (SBV): The Office of Energy Efficiency & Renewable Energy at DOE chose Sandia as one of five leads in a pilot that will give small, clean-energy companies access to national laboratory expertise and resources. As a lead lab, Sandia will allocate $2.75 million in vouchers to companies working in solar, wind, and geothermal technologies. Companies with fewer than 500 employees will be able to apply to Sandia for $50,000 to $300,000 in vouchers that can be used for a variety of technical assistance. (1900, 6100, 6900, and 8300) EC, SSEF

The National Solar Test Facility at Sandia National Laboratories could be used for collaborative research through the Small Business Vouchers Pilot.
(Photo by Randy Montoya)

Sandia established an Academic Alliance to strengthen its strategic university partnerships, signing memorandums of understanding with Georgia Institute of Technology, Purdue University, University of Illinois Urbana-Champaign, University of New Mexico, and University of Texas-Austin. The overarching objective of the Academic Alliance is to advance and help define the future of engineering for national security. AA has three specific goals: solving the nation's big problems; sustaining and engaging human capital; and accelerating the adoption of new technologies. (150, 1200, 1500, 1900, 3500, 6100, 8040, 10600, 11100, 11500) IMS, LF

The NWPMU partnered with the US military academies to provide 29 cadets and midshipmen with opportunities to spend 4-6 weeks working at Sandia. This program allows future military leaders to participate in hands-on work, interact with Sandia researchers, and gain a better understanding of the Labs and its capabilities. The program matched the students with applicable research projects and provided opportunities for the students to tour various areas of the Labs. The program coordinator also provided information on local area attractions and several opportunities for students to network outside of work. (200) NW, NW

PAVEL BOCHEV

Pavel Bochev won DOE's Ernest Orlando Lawrence Award for his pioneering theoretical and practical advances in numerical methods for partial differential equations. Pavel received a medal and a $20,000 honorarium at a ceremony with DOE Secretary Ernest Moniz in Washington, D.C., earlier this year. "This is the most prestigious mid-career honor that the Department of Energy awards," said Bruce Hendrickson, director of Sandia's Center for Computing Research. Said Bochev, "I am deeply honored to receive this award, which is a testament to the exceptional research opportunities provided by Sandia and DOE. Since joining Sandia I've been very fortunate to interact with an outstanding group of researchers who stimulated and supported my work. These interactions, as well as funding from the ASCR Program of DOE's Office of Science and the ASC program of the National Nuclear Security Administration, helped shape, grow, and mature the research effort leading to this recognition."

Engineering sciences

Sandia is managing a 700-mile-long Special Use Airspace that stretches north from Oliktok Point on Alaska's Prudhoe Bay to within 400 miles of the North Pole. Oliktok is the location of the Atmospheric Radiation Measurement Climate Research Facility, where Sandia has conducted research since 1998. The protected airspace will provide a safe zone for researchers collecting climate data and for search-and-rescue teams practicing techniques. The first use of the restricted space was a cooperative rescue exercise led by the US Coast Guard. (6900) EC, SSEF

A helicopter lowers a swimmer into the Arctic Ocean during a search-and-rescue exercise near Oliktok Point. The exercise, which involved UASs and multiple participants, took place in the Warning Area under Sandia's stewardship.
(Photo by Coast Guard Petty Officer 2nd Class Grant DeVuyst)

In partnership with organizations throughout Sandia, Center 1500 delivered an updated document to the B61-12 Life Extension Program that defines design requirements at the system and component level across a broad spectrum of thermal, fluid, mechanical, rad, and electromagnetic environments. The updated version, which represents a critical program milestone, benefitted from an unprecedented level of high-performance computational simulation in addition to ground and flight tests. The specifications are continually updated as new information emerges from flight tests, ground tests, and high-performance computer simulations. (1500) NW, NW

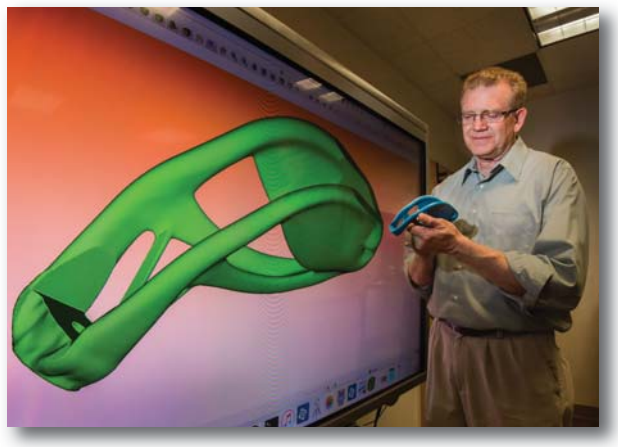
Sandia hosted its second annual Nonlinear Mechanics and Dynamics (NOMAD) Research Institute in the summer of 2015 with support from the University of New Mexico. For six weeks, researchers from across the world collaborated on seven projects in nonlinear mechanics and dynamics with an eighth team focusing on cross-cultural STEM collaborations. Participants included 24 graduate students/post docs and 14 world-renowned staff and faculty mentors from 17 universities across 11 countries. Matthew Brake (1526) was the technical organizer; Michaela Negus (1526) and Diane Peebles (1526) supported the programmatic coordination. (1500) NW, NW

Sandia will play an important role in supporting NASA's Mars 2020 mission by performing the safety analysis and producing the Safety Analysis Report, which is fundamental to the mission's launch decision. Sandia recently performed the Nuclear Risk Assessment that led to NASA's decision to use a multimission radioisotope thermoelectric generator (RTG) to power and heat the rover that will be carried on this mission. Both efforts depend on Sandia's expertise in safety analysis, consequence modeling, and risk analysis. (6200, 1500, 5400) EC, SSEF

Sandia's leadership in an analysis of water resources in the High Plains region, conducted by staff at the National Infrastructure Simulation and Analysis Center (NISAC), gained high visibility with the Department of Homeland Security's Office of Cyber and Infrastructure Analysis (OCIA). These analyses of risks and economic impact of continuing aquifer depletion in Nebraska and Kansas led to Sandia presentations at the Nebraska Infrastructure Protection Conference in September and to the lieutenant governor of Nebraska, as well as follow-on work in other regions. (6900) IHNS, SSEF

Thermal batteries provide essential power for nuclear weapon components. Reduction of design cycles and cost have been realized for several weapon-specific thermal batteries through the use of the Thermally Activated Battery Simulator (TABS). This validated multistep, multiphysics model of thermal battery thermal and electrochemical behavior is routinely being used by battery designers in a desktop graphical user interface to understand and predict battery performance, reliability, and safety. TABS is also being integrated with systems performance models and to support stockpile assessments. (1500, 1800, 2500) NW, NW

A new design technology and environment, PLATO (PLAtinum Topology Optimization), promises to fundamentally change our approach to mechanical design. This design process creates shapes by optimally placing material only where needed. The organic-looking shapes, which were previously infeasible to manufacture, can now be made economically using advanced additive manufacturing. These designs are preferred when space and weight are at a premium. This also opens the door to customized lattice materials where optimal stiffness-to-weight ratios are obtained. (1400, 1500) NW, NW

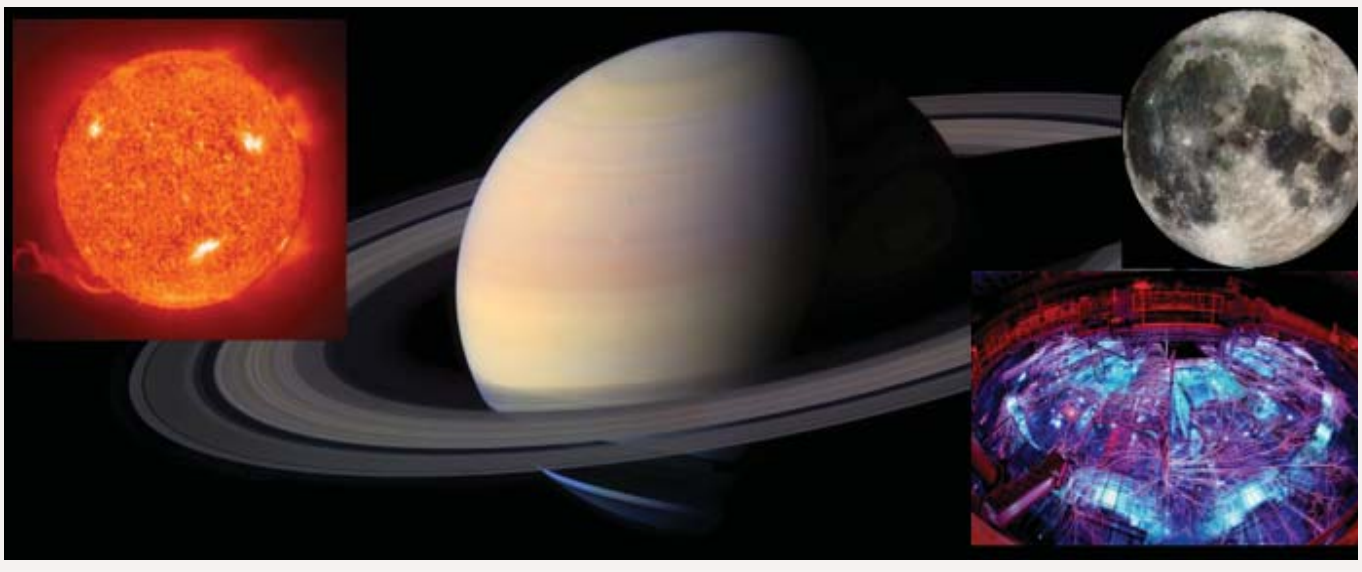


Topology optimization achieved the unique shape of the lantern bracket held by Ted Blacker (1543) and displayed in the topology optimization program behind him.
(Photo by Randy Montoya)

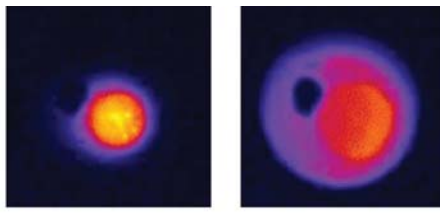
Pulsed power

The conditions created on Sandia's Z machine are literally out of this world — states of matter found in giant planets, meteor impacts, or in the sun are attracting scientists to collaborate with Sandia through the Z Fundamental Science Program (ZFSP). ZFSP made three major scientific discoveries in 2015: The opacity of iron was measured at solar conditions (Bailey et al, *Nature*). Hydrogen was compressed to a metallic state (Knudson et al, *SCIENCE*) and the vaporization threshold of iron was measured (Kraus et al, *Nature Geoscience*). (1600) LF

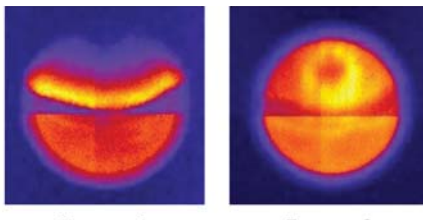
In 2015, experiments on Sandia's Z machine and quantum simulations in the Z Fundamental Science Program made discoveries that help explain iron rain when the moon was formed, the age of Saturn, and the abundances of heavy elements in the sun.



The first in-situ diagnostic images were captured at both the Sandia Z pulsed power facility and the Lawrence Livermore National Ignition Facility using Sandia's ultra-high-speed digital X-ray framing camera. Designed and fabricated in collaboration between the Pulsed Power Sciences and Microsystems and Engineering Sciences Applications centers, the cameras consist of a photodiode array bonded to a radiation-hardened custom readout integrated circuit with nearly half a million 25µm pixels. At 1.5ns temporal resolution, the UXI sensors are the fastest multiframe X-ray imagers in the world. NW, NW,



Hybrid CMOS camera X-ray images on Z (shot H33 - 6/15/2015) at 2ns temporal resolution. The initial Z application was to measure the dynamics of laser-heating of a gas-filled Magnetized Liner Inertial Fusion target.



Hybrid CMOS camera X-ray images on NIF (shot N150901 - 8/27/2015) at 2ns temporal resolution. The initial NIF application was to measure the time-history of the laser entry hole of a NIF hohlraum (figure courtesy of Hui Chen et al., LLNL).

Sandia's Z pulsed power facility uses large currents and the resulting magnetic pressure to compress cylindrical metal tubes (liners) containing fuel to reach the extreme conditions needed for fusion. Instabilities growing up on the outside surface of the liners can limit our ability to do this. Researchers found that by combining strong axial magnetic fields and thick insulating coatings, they could reduce the instability growth, maintaining the inner portion of the plasma liner in a relatively unperturbed state, potentially making fusion conditions easier to achieve. (1600) NW, NW

Military programs

Center 1800 developed effective mitigation approaches for aging-related issues of pilot protection goggles under an Air Force Materiel Command Air Force Life Cycle Management Center work for others agreement. The electro-optic PLZT thermal/flash protection goggles, originally developed by Sandia from 1971 to 1986, were found to be refurbishable using Sandia experience in materials aging, electronic materials development, optical materials, and electronics packaging and encapsulation. (1800) DSA, SDF

Thermal/flash protective device goggle

CPAT is a transformative operations research project for the US Army.

A Sandia-developed analysis capability was one of six finalists for the 2015 Franz Edelman Prize. Over the past four years, the Capability Portfolio Analysis Tool (CPAT) has been used in more than 40 high-visibility studies to inform the Army's Program Executive Office Ground Combat Systems' fleet modernization decisions. CPAT's nomination highlights the tool's technical excellence and the impact it has had on the Army's modernization planning. CPAT analyses have helped prioritize the investment of billions of taxpayer dollars planned over the next 25-35 years. (6100, 9500) DSA, SDP

Last summer, organizations 5447, 5422, 5431, 5435, and 5448 supported a field test of Sandia's Sensor Delivery Dart (SDD) system at a test range near Yuma, Arizona. Twelve SDDs were dropped from an aircraft to test aerodynamic and ground penetration performances. All 12 SDDs performed exactly as predicted. The customer was extremely pleased with this first set of results, produced within seven months of the project start. Two additional and successful test series were performed later in the calendar year. (5400) DSA, SDP

Sensor Delivery Dart in flight and successfully embedded to terrabrakes following impact.

Sandia has demonstrated success in developing a capability to measure the downrange crosswind for long range shooting. Until now, crosswind estimation relied exclusively on the judgment of highly trained and experienced snipers. An affordable hand-held or rifle-mounted technology has been demonstrated at our outdoor optical test range and live-fire testing with special operations snipers. Funding is being provided by various interested defense forces. (5300, 6500) DSA, SDP

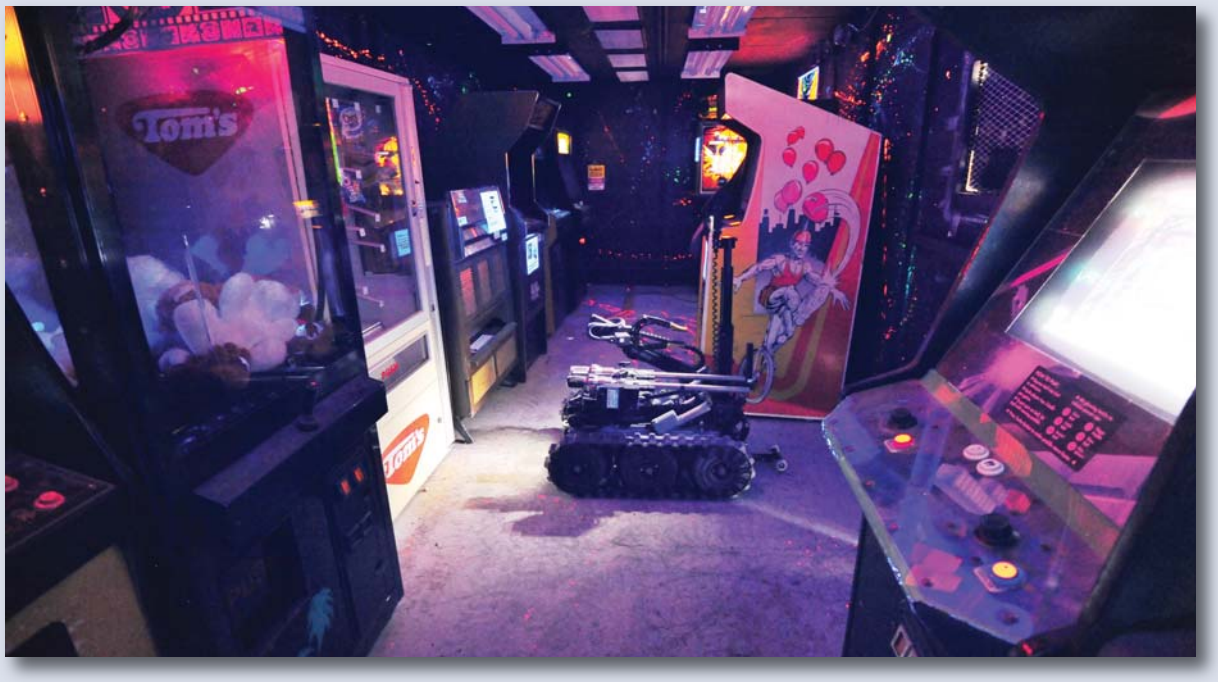
The Sensor Exploitation Applications department has delivered several new target models that expand the capability of the F-35's Synthetic Aperture Radar targeting system. Sandia continues to work with Northrop Grumman and Lockheed Martin to expand this capability. Sandia has led research and development of Synthetic Aperture Radar Automatic Target Recognition (ATR) technology for 25 years. Sandia's ATR is sought by both DoD and defense contractors because of its software maturity, processing efficiency, and decision accuracy. (5400) DSA, SDP

Flight Test Standard Missile-25 (FTM-25) was successfully conducted Nov. 6, 2014. A ballistic missile launched from Sandia's Kauai Test Facility and two cruise missiles were detected, tracked, and engaged by the destroyer USS John Paul Jones. This test was the first live-fire event of the Aegis weapon system in Integrated Air and Missile Defense Radar Priority Mode, engaging a ballistic missile target and a raid of cruise missile targets. In addition to launch operations, KTF provided telemetry, target displays, countdown, photometrics, and other range support. (5400) DSA, SDP

The FTM-25 ARAV target vehicle being launched from KTF Pad 1.

Homeland security

In May, Sandia teamed with Los Alamos National Laboratory to conduct the 9th Annual Western National Robot Rodeo. Bomb squads from across the country competed in emergency scenarios that required their robots to perform life-saving actions. Nine teams competed, with top honors going to the Dona Ana County Sherriff's Office. In June, a Sandia team demonstrated its walking humanoid emergency response robot, WANDERER, at the DARPA Robotics Challenge. WANDERER's novel energy-efficient actuation and drive-train technologies will enable much longer emergency response missions without recharging batteries. (6500) IHNS, GNAS



A bomb squad robot attempts to clear a room that has a very confusing environment (lights, sound, strobe effects, etc.).
(Photo by Randy Montoya)

Microelectronics & microsystems

During 2015, Sandia was selected to receive four advanced analysis tools that came out of the Intelligence Advanced Research Projects Activity Circuit Analysis Tool (CAT) program. The semiconductor industry continues to scale with Moore's law, producing components at the 22 nm technology node and below that challenge most commercial analysis capabilities. The CAT program enabled industry partnerships in advanced R&D in the area of failure analysis. The rapid planning, preparation, and successful installation of these tools at Sandia has already enabled new research in areas like silicon sample preparation and high-resolution imaging and is addressing a variety of mission area needs. DSA, Cyber

Zeiss ORION NanoFab

Energy

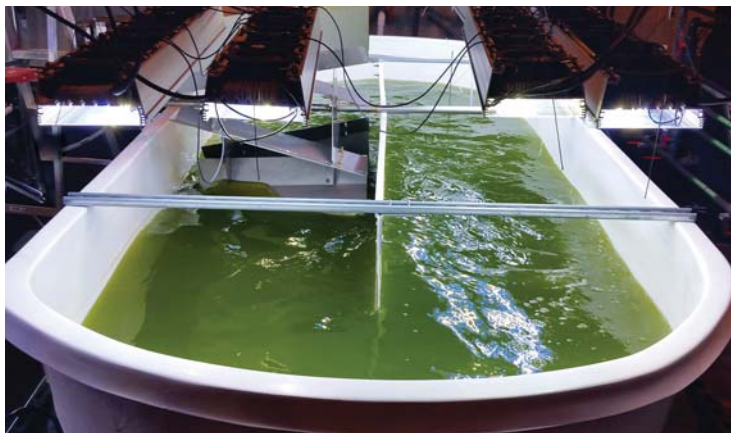
Sandia's National Solar Thermal Test Facility (NSTTF) was used for extensive baseline performance testing of heliostat prototypes by the renewable energy company SolarReserve. The company is developing advanced heliostat designs and control algorithms to increase the efficiencies of its solar power systems, which are deployed around the world. SolarReserve chose the NSTTF because of Sandia's "knowledge and reputation in the solar industry, as well as the breadth of resources available for improving and testing new designs." The testing at Sandia led to important component modifications. (6100) EC, SSEF

Roger Buck (middle, SolarReserve), Subhash L. Shinde (farthest) and William Kolb (closest) examine SolarReserve's SR96 Heliostat. The reflection shows the optimized beam shape produced by this heliostat on the 200-foot-tall Solar Tower. (Photo by Randy Montoya)

The Sandia Wake Imaging System is a prototype Global Doppler Velocimeter designed to measure large scale inflow and outflow wind patterns associated with wind turbines. When fully implemented, this measurement type will be the first of its kind and will lead to improved predictive wind farm flow patterns. The results from this work will lead to improved turbine and wind farm designs to achieve higher energy efficiency rates. (1100, 6100, 5700) EC, SSEF

Sandia engineers Katrina Groth and Ethan Hecht won the Robert Schefer Best Paper award, presented at the 2015 IA-HySafe International Conference on Hydrogen Safety. Their paper, chosen from 167 submissions to the conference, describes the Hydrogen Risk Assessment Model (HyRAM), a toolkit for modeling the safety of hydrogen storage and fueling systems. The toolkit will aid the hydrogen codes and standards community as it develops models of hydrogen releases to support deployment of hydrogen refueling infrastructure and hydrogen fuel cell technologies. (6200, 8300) EC, SSEF

A very high-precision, high-power machine to test batteries was developed with external partners Ford and Arbin. It delivers 200 amps with precision six times better than previous testers. The machine was developed as a tool to allow researchers to better predict the life of a rechargeable battery. This is crucial for electric vehicle or stationary storage batteries that must last a decade or longer. The objective is to use high-precision measures during early performance to extrapolated behavior over the life of these batteries. (2500) EC, SSEF

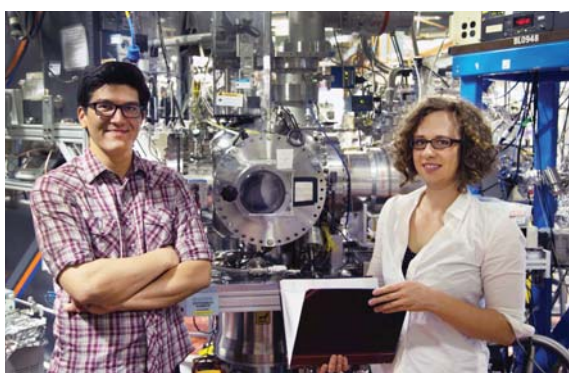


Sandia has implemented an algal testbed research facility designed to understand and mitigate pathogens and predators that can "crash" algae cultures, a critical barrier to commercializing algae biofuels. Unique to this facility are advanced hyperspectral monitoring and metagenomic diagnostics developed at Sandia that provide real-time cell density and health of the algae. When completed, the temperature and lighting can be controlled to simulate different geographic locations and environmental conditions. The three 1,000-liter raceways are geometrically similar to commercial units for scale-up from lab to field. EC, SSEF

Algal testbed designed to understand and mitigate pathogens and predators that can "crash" algae cultures.

Sandia has formed an industry-funded Spray Combustion Consortium to build on the foundational scientific knowledge generated under DOE-funded projects and develop validated, predictive tools enabling the design of advanced direct-injection engines. The consortium is a partnership among Sandia, Argonne National Laboratory, the University of Massachusetts, vehicle and engine manufacturers, and commercial computational fluid dynamics software vendors. To date, six industry partners have signed on to support this effort at a level of $100,000/partner/year, and negotiations are continuing with several others. The three-year project began Nov. 10. (8300) EC, SSEF

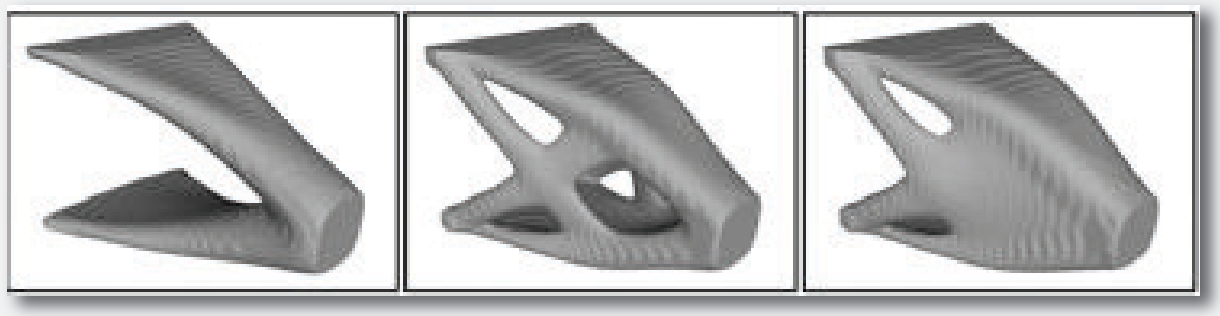
Sandia researchers are the first ever to directly measure a "QOOH" radical, a key reactive step in the chain of reactions in hydrocarbon oxidation. Because QOOH reactions help determine both ignition chemistry and the production of organic particulates, the QOOH reaction rates and outcomes from this breakthrough can increase the fidelity of models used to create cleaner and more efficient cars and trucks, and improve the description of oxidation processes that can lead to aerosol haze in Earth's atmosphere. (8300) EC SSEF



Sandia scientists John Savee, left, and Eve Papajak (both 8353), are responsible for detection of QOOH intermediates, shown at Berkeley's Advanced Light Source, where the experiments were done.

(Photo by Randy Montoya)

Materials



Topologically optimized designs for a thermally conductive mechanical bracket. Priority for thermal performance (left), both thermal and mechanical performance (center), and mechanical performance (right).

To fully leverage the design freedom of additive manufacturing, Sandia has and continues to develop tools for directly computing the design of components and systems that optimize relevant performance objectives (for example, thermal, mechanical, and electrical) while meeting essential requirements (such as volume and mass). These optimization-based design tools allow engineers to explore more freeform or "organic" topologies with only performance goals dictating the final design. This new capability is built on Sandia's extensive computational investments (in Trilinos, Sierra, and Albany, for example) and leverages high-performance computing resources. (1400, 1500), NW, NW

Nano-ionic resistive memory devices or "memristors" are needed to enable neuromorphic computing with a significant reduction in power consumption. Using ion-aassisted deposition (IAD), Ron Goeke and Carl Smith (1832) have developed a method to make memristor devices reliably. The IAD deposition approach involves e-beam evaporation of tantalum metal with a reactive beam of argon and oxygen ions impinging on the growing film. Using this technique, the oxide formation occurs at the substrate, resulting in better control over film stoichiometry and yielding low variability. (1800), DSA, SDP

HR, finance, & legal

The Employee Health Services Team (3300) was instrumental in Sandia winning the New Mexico's Healthiest Employer 2015 Award in the large company category. To compete for the title, companies submit a comprehensive nomination questionnaire and an online survey. Employers are scored using the Healthiest Employer Index (HEI), which measures factors such as an organization's wellness culture, strategy, communications, programming, and analysis. Out of a possible 100, Sandia's HEI score is 86.92 whereas the national average is 49.23. (3300) IMS, LF

Sandians participate in annual Fitness Day activities, one of many ways the Laboratories fosters employee health and wellness. (Photo by Randy Montoya)

The 90-day Welcome Wagon initiative is targeted at employees new to the Financial and Business Management Center. It ensures that individuals understand the importance of Sandia's safety culture. During their first week, new employees will be greeted by their skip-level manager to discuss the 90-day experience. The employee's immediate manager will continue the safety discussions and assist with various 30-, 60-, and 90-day safety challenges. The Welcome Wagon will roll out across all of the CFO and Business Operations Divisions during FY16. (10500) IMS, LF

In FY15, the Business Staffing Team (BST) interviewed more than 1,000 applicants and hired approximately 130 regular employees and 60 student interns for the Business Community. The BST engaged in campus recruiting at more than 10 universities and brought in experienced business management professionals, project controllers, cost analysts, supply chain representatives, audit, and specific-need candidates for interviews. The BST has been recognized as a best practice at the Labs. (10600) IMS, LF

(Photo by Randy Montoya)

ANN RILEY

Ann Riley was recognized by Women's Enterprise as a Top 100 Leader at the Women's Business Council Southwest "Salute to the Stars" event. Ann, a Small Business Advocate, was noted as one of the best and the brightest among Women Business Enterprises and the companies that track their unique contributions. She was selected as an influential leader who has gone above and beyond to ensure inclusive supply chains, and that puts her and Sandia in the top 100 for corporate supplier diversity.

The Reapplication Team makes a difference in the lives of children in our community. This year's K-12 event resulted in the successful donation of 2,341 computers and laptops, valued at more than $4.1 million, to 34 New Mexico schools. The Reapplication Team received excellent feedback from the schools, which indicated the computers and equipment will be used to establish new computer centers and replace aging computers and equipment. Providing surplus computers is a community service and demonstrates good stewardship of assets. (10200) IMS, LF

The Retirement Investment Management organization completed additional benchmarking and fee negotiation projects resulting in reductions of investment fees for both the Retirement Income Plan (pension) and the Savings and Income Plan (401(k)). These reductions began in FY15 and will continue in future years, helping increase the funded status of the pension and providing greater net investment returns to participant accounts in the 401(k). (10500) IMS, LF

In FY15 the Total Rewards team refined processes and delivered quality improvements. Compensation & Performance designed and requested a market band structure update and geo-differential adjustment from DOE/ NNSA and received approval for both, in addition to providing performance management training and a new consolidated Compensation website. Retirement, Savings, and Absence Management launched a self-service retirement estimator, implemented the FMLA rolling 12 calculation method, and a new behavioral health return-to-work model to assist employees in their transition back to work after an absence. (3500) IMS, LF

In FY15, Human Resources' Talent Acquisition Department hired 1,058 new staff into the Labs, an increase of 66 percent over the prior year. This effort required significant coordination within the department and coordination with HR's Talent Management & Development (TM&D) team to deliver onboarding and to meet a 12 percent increase in demand for training. TM&D also significantly enhanced Sandia's management development program, combining existing classes into a competency-focused list for management and emerging leaders. (3500) IMS, LF

Sandia's Diversity & Inclusion Organization in collaboration with strategic partners from across the Labs, has created a variety of learning and awareness programs geared to actively engage employees in workplace diversity and inclusion dialogue. This includes Sandia's Diversity Cinema and Workshops-in-a-box tools, which were recently identified as a best practice in the DOE complex. Sandia was invited to present these proactive employee engagement practices at the September National Laboratories Directors Council Diversity Forum. Mission Support (3010) IMS, LF

The Accounting Services and Payroll departments were awarded the 2015 Piñon recognition award by Quality New Mexico. Through assessments and site visits, the departments demonstrated systematic processes and data that strengthened overall operations and attained improved outcomes. Accounting Services focused on providing accurate reporting of Sandia's financial results and tax filings while Payroll focused on providing accurate payment of compensation and excellent customer service. Their efforts proved they are a model organization committed to providing the best products and services to their respective customers. (10500) IMS, LF

The W87 Fuze AFA and its components realized earned value process, metrics, and reporting that empowered project management and met rigorous customer objectives through the efforts of organizations 10620 and 10650. This success demonstrates collaboration between Sandia/New Mexico and Sandia/California organizations and provides high-fidelity insight into schedule and cost performance, impacts, and options for corrective action. It also affected broad management use, including a newly implemented monthly PM/EVM review, and met with customer approval at both the FY15 Internal Baseline Review and the FY16 Schedule Surveillance events. (10600) NW, NW

Chemicals play a huge role in supporting Sandia's mission, and understanding and managing those chemicals can be time-consuming and tedious. The Lifecycle Materials Management (LCMM) program determined that Sandia needed a better way to track chemicals used — that's where RFID came in. Since the RFID program began, LCMM has reduced the number of chemicals by more than 30,000 and taken reconciliation from hours/days to seconds/minutes. This gives chemical users more time to do the valuable research they perform in support of Sandia's mission. (10200) IMS, LF

LCMM use of RFID reduces reconciliation time and increases research time.

Community Involvement, Government/Media Relations, and Communications

After Sandia helped build a controlled fog chamber to test sensors for defense and other applications, various communication efforts amplified the impact of the development. News accounts based on a news release, along with social media promotions, led to several business leads. The US Army's Night Vision and Electronic Sensors Directorate plans to begin testing this year, several businesses contacted Sandia after the news release was published, and FedEx contacted Sandia to inquire about using the fog chamber for its R&D. (3600, 1100, 6500, 2100, 1700) IMS, LF

Sandia developed a fog chamber to test optics, like security camera sensors, in a controlled environment. Sandia chemical engineer Andres Sanchez checks an instrument that measures the particle size and concentration of the fog in the chamber's atmosphere. (Photo by Randy Montoya)

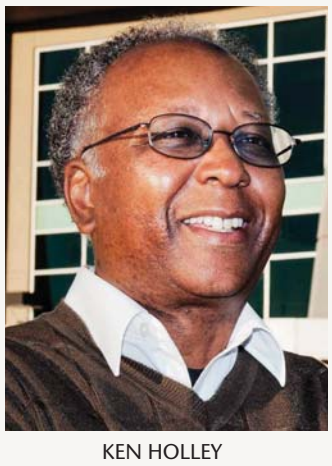
Media Relations, in collaboration with NNSA and technical organizations across the Labs, hosted a national crew from PBS *NewsHour* for a day to examine work on the B61-12 Life Extension Program and discuss stockpile stewardship. The nine-minute broadcast on Nov. 5 portrayed Sandia positively to a national audience and included footage from other NNSA sites. (3600, 2100, 2500, 1500, 1300) IMS, LF

While Sandia's social media program consistently wins awards, recent recognition reached a new level. Darrick Hurst, a driving force behind Sandia's use of social media to amplify the Labs' accomplishments, won the Apex Grand Award in FY15, as well as the Academy of Interactive and Visual Arts Communicator Award of Distinction and the PRSA Cumbre Award. Sandia's social media channels continue to grow significantly (28 percent growth across Facebook, Twitter, LinkedIn, and YouTube). *WIRED* magazine featured Sandia social media as one of five best places to follow "spectacular science." (3600) IMS, LF

Darrick Hurst, a driving force behind Sandia's use of social media to amplify the Labs' accomplishments, won three awards in FY15 for Sandia's social media strategy and its impact. (Photo by Randy Montoya)

Governance, leadership, & management

Recruiting Specialist **Ken Holley** was selected to receive the prestigious Community Service Award at the annual Black Engineer of the Year Awards STEM Conference Feb. 18-20, 2016, in Philadelphia. Ken was nominated by HR VP Melonie Parker and received letters of recommendation from current and former Sandia executives as well as diversity recruiters and university officials. In addition to his involvement and leadership with numerous education and community organizations, Ken has an outstanding record serving Sandia in recruiting-related activities for more than 30 years. Ken was also named a recipient of a 2015 Outstanding Service Award from the New Mexico Office of African American Affairs. This award honored Ken for his contributions to educational advancement and economic empowerment in New Mexico's African American community. Ken joined Sandia in 1985 and holds a B.A. degree from Winston Salem State University and an MBA from Oral Roberts University.



(Photo by Randy Montoya)

KEN HOLLEY

Approval of CREATE CD-1, Authorization to pursue development of Alternative Finance Proposal:

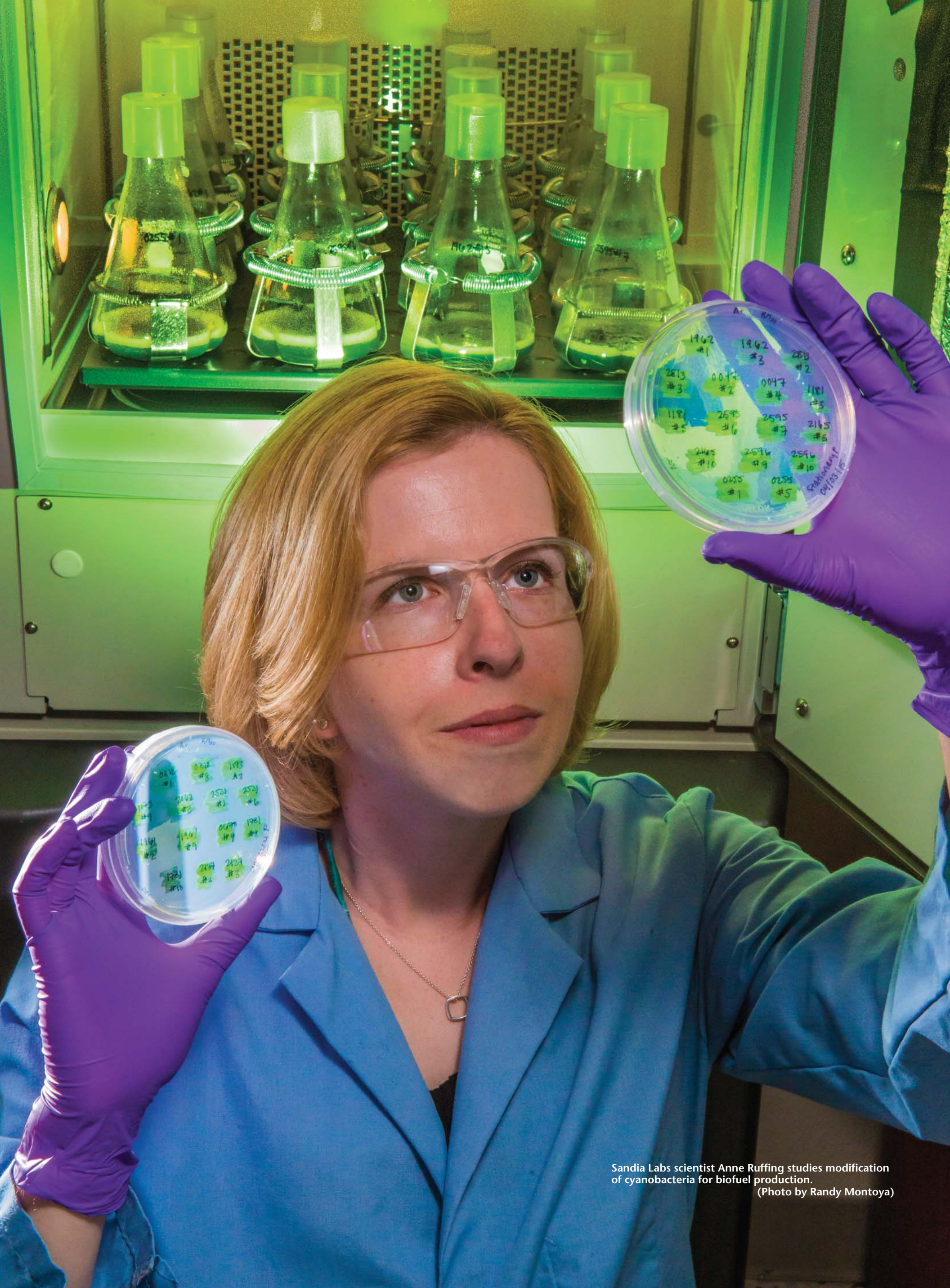
- Enables Sandia to expand and enhance collaborative programs in hydrogen science, additive manufacturing, cybersecurity, energy, and biosciences;
- Further defines the Livermore Valley Open Campus as the "front door" for the California site;
- Shifts unclassified activities to General Access Areas, making room in Limited Areas for growing classified work; and
- Provides a modern workspace to attract and retain a world-class workforce. IMS, LF

Sandia's Prime Contract Group (11011) partnered with the NNSA Sandia Field Office to successfully update the current Prime Contract with more than 60 new clauses. The hard work and long hours put in by the Prime Contract Group facilitated DOE's announcement that it has extended the current contract through April 30, 2017, thus enabling Sandia to continue undisrupted its focus on mission deliverables. (11000) IMS, LF

Sandia's Subcontract Audit Department supported the DOE complex in establishing a robust subcontract audit program. Members of the department were featured presenters at a three-day subcontract audit training forum offered to audit and procurement professionals from 11 DOE sites. They shared experience gained through auditing subcontractors to Sandia, including risk analysis techniques, regulatory requirements, and Sandia's strategies for assuring a risk-based approach to placing and auditing contracts. (0800) IMS, LF

The Operational Innovation Office drives increased integration and efficiencies across Sandia by exploring opportunities, benchmarking and researching outside of Sandia, gathering ideas at all levels of the organization, providing tools, measures, Lean Six Sigma and Design Thinker training and services, and communicating results for continuous improvement. The efficiency goal for FY15 was $75 million. Sandia achieved $132.8 million in FY15 cost savings and cost avoidances, which exceeded last year's result by $40 million. (700) IMS, LF

The Quality Maturity Assessment (QMA) completed the second year of a three-year plan to assess quality outcomes and identify opportunities for Labs-wide improvement. Opportunities identified in the FY15 QMA are being addressed in partnership with the Quality Roundtable (QRT), a cross-organizational community with representatives from all divisions and PMUs. The collaboration between QMA and QRT has increased workforce understanding and implementation of quality-related principles and is leading to sustainable improvements. (0700) IMS, LF



Sandia Labs scientist Anne Ruffing studies modification of cyanobacteria for biofuel production.
(Photo by Randy Montoya)